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ABSTRACT

As the world grapples with increasing environmental, social, and security problems, population is rarely considered a cause or contributing factor. The relationship of population to the human condition, and to the condition of the Earth, is often subtle and complex. But population growth affects almost every aspect of life from education to employment to the environment; it contributes to hunger, migration, war, and disease. This curriculum unit on population issues for high school and college students is divided into the following essay and information sections: "Introduction: Who Cares about Population Anyway?"; "A Brief History of World Population"; "How Many People Can the Earth Support?"; "Tracking the Trends: A Look at Key Indicators"; "Population and the Environment"; "Economic and Social Impacts of Population Growth"; "Population and Religion"; "Does the U.S. Have a Population Problem?"; and "And Now the Good News: Personal and Global Solutions." This curriculum guide aims to deliver a well-rounded understanding of population issues to high school and college students. The guide is divided into the following sections: (1) "How to Use the Curriculum Guide"; (2) "Goals and Objectives"; (3) "Curriculum Guide by Issue"; (4) "Population Ethics Issues"; (5) "Hands-On Illustrations and Activities"; and (6) "Additional References and Resources." The first section offers a scope-and-sequence for three teaching scenarios: 1-day, 1-week, and 9-week units. Most sections of the guide offer two sets of problems: discussion questions for classroom study and research assignments for independent study. The activities and hands-on illustrations require preparation and may be used as stand-alone lesson plans. The unit is designed to conform to the standards of Goals 2000, the National Council for the Social Studies, and the National Council for Geographic Education. The unit's goals are: understand the interconnectedness of population growth and key issues confronting the world today; understand patterns of population growth and change within the community; understand historical population facts in a time sequence and alternative future scenarios; become aware of personal responsibility for and power to help solve population and related global issues; and develop a means of communicating to the community that sustainable human numbers are essential to human and ecological well being. (BT)

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As the world grapples with increasing environmental, social, and security problems, we rarely consider population as a cause or contributing factor. Perhaps because population issues are associated with controversial or uncomfortable subjects like sexuality, contraception, and abortion, we don't like to talk about it.

We express concern about deforestation, global warming, and the extinction of plant and animal species. We are appalled by pictures of starving people, and the mutilated bodies of civilian and military casualties of wars and revolutions. We complain about crime, pollution, and congestion. But we almost never consider that every one of these problems is driven by our own increasing numbers, and by the lifestyles many of us choose to live.

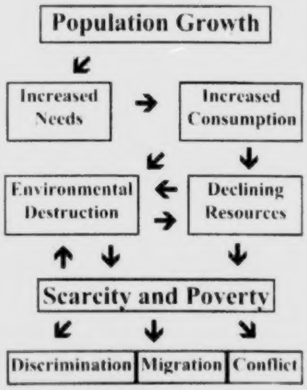
The relationship of population to the human condition, and to the condition of the Earth, is often subtle and complex. But population growth effects almost every aspect of our lives – from education to employment to the environment. It contributes to hunger, migration, war and disease.

To see these connections, it is first necessary to understand that the world is a complex system, and that all of these issues are completely interconnected. Every event that occurs in one part of the system affects, in countless large and small ways, every other part of the system.

The World is growing by 80 to 85 million people each year. The pressures of that growth (along with the needs of the 6 billion of us already here) cause or multiple our most pressing enviornmental, social, and security issues. FAO photo.

Picture a mobile hanging from the ceiling. Even though it appears that the pieces hang in isolation, they are completely interconnected and delicately balanced. A breath of wind or a slight pull on any individual piece causes all the others to move as well. A sharp tug on one piece causes all the others to jump. And if one piece is removed - if the string holding it is cut - the entire system tilts, and may even collapse.

The Population Mobile



The larger the population, the more resources we consume, and the more environmental damage we inflict. When there are too many people for available resources, scarcity and poverty result. Scarcity then drives migration, conflict, and greater environmental destruction.

From a population perspective, the mobile looks like this. When human numbers increase, human needs also increase. We meet those needs by consuming more resources. That consumption causes environmental damage, because the environment is the source of all our essential resources. As more resources are consumed, fewer are available. Resources also become more scarce as environmental damage increases, because the damaged environment can't produce as many resources.

This resource scarcity causes a number of problems. If there isn't enough food, people go hungry. If there isn't enough water, people are thirsty. If jobs are scarce, people are unemployed. And if money is scarce, people fall into poverty.

The way people respond to scarcity also causes problems. We work the environment even harder to obtain resources, and do even more damage.

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Sometimes we refuse to share with those of a different race, religion, class, or gender. (In some cultures, when food is scarce, males are fed and females go hungry.) When scarcity is acute, people may be forced to migrate in search of food, farmland, employment, or whatever resources they need. In some situations, they may revolt against the government, begin "ethnic cleansing," or go to war against their neighbors to seize their resources.

Children help support their families by herding animals in Rwanda. In many developing countries, extra children is an econmomic asset, while in many developed countries the cost of having and supporting children encourages parents to control their reproduction. FAO photo

And Now We Are Six

World population reached six billion in 1999, and is currently increasing by 80 to 85 million people each year. Depending upon the choices we make over the next few decades, the United Nations projects world population in 2050 could be anywhere from 7.3 billion to 10.7 billion. That range assumes fertility will decline considerably in the future. If we continue to grow at the same rate we are today, the Earth's population in 2050 will be 14.4 billion!

A number of factors drive this growth. One is that, even though fertility rates have come down worldwide, there are now more people of childbearing age than ever before. (Just over half the world's population is under age 25.) As those three billion people start families over the next few decades, world population will likely increase by several billion.

Another reason for continued high levels of population growth is that fertility rates remain relatively high in some populous regions such as Africa and South Central Asia. Africa's birth rate is almost 70 percent higher than the world average, and nearly four times that of the more developed nations. South Central Asia, where nearly one-quarter of the world's people live, has an average birth rate 30 percent higher than world average, and almost three times as high as the more developed nations.

Generally speaking, population growth is higher in those regions because levels of income and education are lower. People tend to choose the number of children they have for economic reasons; in poorer societies, children are often an asset. They help raise food, haul water, gather fuel wood, or work for wages outside the home. When having more children improves their economic security, people tend to have more children.

Education is also closely linked to population. The more education people have, the more economic options they generally have, and the fewer children they are likely to want or need. In the areas of the world where fertility is lowest - Europe, Japan, China, the former Soviet Bloc, and North America - education levels are correspondingly highest.

Finally, population is growing because declining mortality and increased longevity have shifted the balance between births and deaths, somewhat offsetting falling birth rates. Overall, population is still growing rapidly because more people are having children (even though they have fewer children on average); birth rates are higher in some of the most populous regions; fewer people die prematurely, and more people live longer. This combination has pushed world population from about two-and-a-half billion in 1950 to over six billion at the turn of the century.

What's Your Shoe Size?

That kind of rapid growth exerts severe demands on natural, social, and economic systems because every human being has basic needs. These include food, water, shelter, energy, and waste disposal. Each of those needs must be met by exploiting the environment and consuming resources. The more people on the planet - and the greater the average level of consumption by any individual or group - the more resources are required to meet those needs.

Scientists sometimes express this using the concept of ecological or environmental "footprints." Viewed that way, every person has a footprint that falls on the environment. At the most basic level, it includes enough land to produce food and fiber - to raise crops and graze animals and grow trees - and enough clean water to drink, wash and irrigate. We also need enough land to supply some sort of energy for heating and cooking, and to safely dispose of the wastes we generate. The more people on Earth, the larger the total human footprint on the planet, and the less room remains for other species and natural systems.

As individuals' lifestyles and consumption expand, so do their footprints. As nations become more industrialized and their standards of living increase, they consume more resources and exert a larger footprint. They need more farmland to support higher protein diets, and often have to clear forests, plow prairies or fill wetlands to provide it. They need more water, and have to tap more lakes and aquifers, and dam and divert more rivers. They need more energy, and have to build more power plants, burn more fuels, and release more pollutants.

Growing populations and higher levels of development also require additional infrastructure and increased levels of social and community services. Additional people need additional houses, hospitals, roads, schools, parks and playgrounds. More highly developed societies, because their consumption is greater, use more land and resources per person. To support their economies and produce consumer goods, they require more factories, offices, businesses, and shopping centers. To dispose of their wastes, these societies need more landfills, sewage systems, and toxic containment sites.

Hungry in Bhutan: Rapid population growth makes it difficult for governments to meet the needs of their people. Depending on population size and available resources, food, water, education, health care, and jobs may be scarce.
FAO photo

Larger populations also require expanded bureaucracies, more social health and emergency services programs, and larger criminal justice systems. They then must impose higher taxes and fees to support those services.

All these processes result in greater environmental impacts, such as deforestation, soil erosion, extinction of plant and animal species, and pollution. Human health suffers from air and water pollution, toxic chemicals, and increased environmental stress.

Scarcity and Scuffles

As world population and consumption grow, environmental impacts multiply, and resource scarcity worsens. As environmental destruction and scarcity spread, and as more people compete for limited resources, social, ethnic, and political tensions increase. This combination drives political instability, declining social health, and greater migration. As shortages of essential resources such as water, farmland, and fisheries reach critical levels, security analysts expect conflict over those resources to intensify.

The combination of population, consumption, and scarcity has fueled more than 150 wars since the end of World War II. It has driven tens of millions of people from their homes as economic migrants or refugees. And it has devastated vast areas of the Earth's surface through environmentally destructive practices.

Ultimately, our own numbers, and the lifestyles many of us choose to live, drive all the critical issues we confront. Left unchecked, the combination of population growth and consumption - along with increasing inequity between rich and poor individuals and nations - will ultimately threaten not only the well-being but even the lives of a majority of people on this planet.

And Now the Good News

A future of scarcity, inequity, and conflict is not inevitable. We already possess the knowledge, the technology, and the resources to create a just, secure, and sustainable world. The challenge we confront - the greatest in the history of the human species - will be to make the necessary cultural, structural, and ethical shifts to achieve that outcome.

The systems model of the mobile demonstrates how seemingly small actions can have a large impact. And this applies to solutions as well as to problems. It is important to remember this relationship, and thus understand the power of the personal choices we make - whether positive or negative - in the larger view.

Solving the problem of population growth will also help solve the environmental, economic and social problems we confront; solving those environmental, economic and social problems will help solve the problem of population growth. As the United Nations Conference on Population and Development reported, "Efforts to slow population growth, to reduce poverty, to achieve economic progress, to improve environmental protection, and to reduce unsustainable consumption and production patterns are mutually reinforcing."

On a personal level, there are a number of things each of us can do. Most importantly, we can control our own fertility. (This means having two or fewer children. Being child-free is also an option.) We can also lower our own consumption and environmental impacts, and we can support political and structural solutions to stabilize population.

Obviously, individuals can't effect political and structural solutions on their own. But they can help raise awareness, promote discussion, and influence local, regional and national policies. Many of these solutions can be implemented at state, county, city, or even neighborhood levels, through land use actions and budget priorities and allocations. Many are already being implemented at some level around the world. Individuals can support and contribute to groups involved in that work, lobby their representatives to support and fund that work, and join in that work as volunteers.

Women in a Bangladesh fishing village learn how to receive and manage credit. Educating and empowering women is a key component of stabilizing population.

The most important structural solution to population growth is universal access to reproductive health care, including family planning and sexual health. If every couple in the world could reliably and affordably choose the number and spacing of their children, world population growth would slow by an estimated 20 percent almost immediately.

Investment in community health care is also necessary. Adequate health care would significantly reduce infant, child and maternal mortality, and allow community members to be more socially and economically productive. In much of the world, parents now expect one or even two of their children to die of hunger or disease before age five. If they have a reasonable expectation that their children will survive and be healthy, they won't need to have "extra" children.

Educating and empowering women is extremely important. Women with higher levels of education tend to marry later, bear children later, and have fewer, and healthier, children. More educated women generally have higher incomes, more economic options, and more power in their families and communities.

Universal access to education is another essential piece in stabilizing population. More highly educated people tend to have fewer children because they also tend to have higher incomes. At a certain level of income, children cease to be an economic asset and become a liability, so people have fewer of them.

Protection and enhancement of human rights is necessary so that all people have access to the requisites of a decent life. Focused anti-poverty efforts, including micro-development and access to credit, are also key components. Improving people's social health and economic well-being can move them out of poverty and away from needing more children for survival.

Environmental protection and restoration efforts that take into account economic needs and realities must also be accelerated. Focus points include conservation and enhancement of critical renewable resources through regulatory and tax strategies, development of sustainable technologies (especially energy), and transfer of those to developing regions

We know that these solutions work. Since 1950, total fertility has fallen 50 percent worldwide. Infant Mortality has declined by more than half in the last 35 years, and average longevity has increased from 45 to 65 years. More people are literate, more live under democratic governments, and more environmentally sensitive areas and threatened species are under some sort of protection.

We need to enhance, expand, and accelerate all these efforts, however. Because of population growth and consumption, there is less farmland, less fresh water, and less forested area available per person every year. Pollution is increasing, more species are going extinct, and roughly one-third of all people are malnourished.

We have the knowledge, the technology, and the resources to solve all of these problems. What we lack is the necessary understanding and commitment to do so.

The choices we make about this in the next few decades will determine whether the world of the 21st century will be one of hope and opportunity, or scarcity and destruction.

A Brief History of Population

Six Billion and Counting
How on Earth did we get here?

Impacts of Growth
The good, the bad, and the ugly.

The System Fights Back
Famine, plague, destruction, and war

The Age of European Expansion
New world, old problems

The Industrial Revolution and the Age of Science
More production, more people

The Modern Era
The population (and consumption) explosion

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Six Billion and Counting - How Did We Get Here?

World population exceeded six billion in mid-1999, and is growing by an estimated 80 to 85 million people each year. According to United Nations estimates, we will add another billion people every 12 to 13 years for the next few decades. Both this number of people and this level of increase are unprecedented in human history. Both create challenges to the natural environment, and to the quality of human life, previously unimagined.

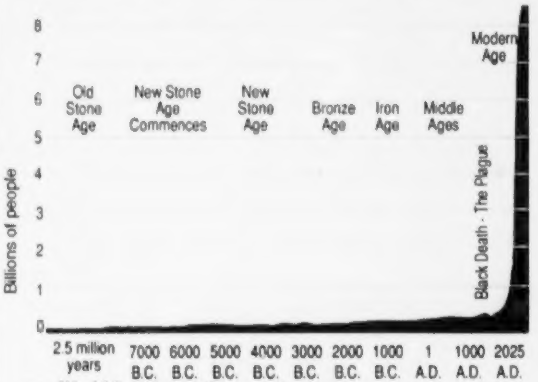
Through nearly all of human history, our ancestors lived as hunter-gatherers. They lived in small clans or tribes, and followed the migration of animals and the seasonal growth of edible plants. But from about 8,000 to 15,000 years ago - in a variety of locations around the world - they began to take up a settled existence.

The reason for this fundamental change in the way people lived was quite simple - human numbers had grown to the point that it had become necessary. The population had outgrown the capacity of hunting and gathering to support it. (Depending upon the productivity of local ecosystems, it may take as much as one to three square miles of land per person to support a hunter gatherer lifestyle.)

Humans had already penetrated and colonized all the continents by then. They had begun to modify their environments, burning grasslands, clearing forests, and hunting many large species to extinction. Except in areas too cold, too hot, or too dry to support them, they had exploited local ecosystems to the best of their ability. And, apparently, in a variety of regions around the world, they had reached the limits of local resources.

The need to feed larger populations forced people to take up agriculture, because farming produces anywhere from 10 to 100 times as much food per unit of land as hunting and gathering. Human ingenuity and technology made this transition possible, because people had by this time learned how to sow crops and domesticate animals. The need to tend and defend their fields and pastures then required the founding of fixed settlements.

World Population Growth Through History



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When this fundamental shift from hunting and gathering to farming, and from a nomadic to a settled existence, began, the earth's population was still quite small, perhaps five to ten million. That number had increased only slowly over the previous two million years, because life was hazardous and short. People probably lived only 20 to 25 years on average, and almost as many people died each year from hunger, accidents, or disease as were born.

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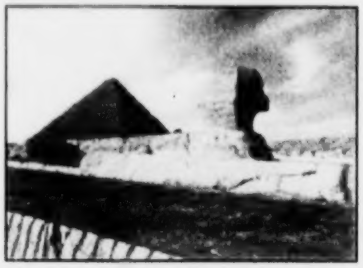
Beginning with the Age of Agriculture, however, humans began to prosper, and population began to grow dramatically. (One of the basic realities of biology is that when any organism has excess food and available habitat, its numbers increase.) Farming produced a lot more food than had ever been available in the past, and population grew in response. More people then needed more food, so production was increased, allowing population to grow even further.



arger populations in ancient Egypt provided abor to construct public works projects such s canals and pyramids. Photo by John Goekle

From an anthropological perspective, the convergence of agriculture, a settled existence, and population growth is a fascinating time. A number of significant changes occur that we identify with the emergence of civilization.

One of the first changes is architectural. When societies have excess food, they typically build walls to protect it, and people begin to live within those walls.

Farming and Fertility

As people turned from hunter gatherers to farmers in the Neolithic period, population began to increase significantly. This was partly due to increased food supplies, which could support more people. It was also likely due to a decline in mortality as people took up a settled and more secure existence. But it also occurred because fertility apparently increased significantly for the first time in human history. Because of their nomadic lifestyles, hunter gatherer societies tend to have fewer children. A mother in such a society cancarry only one child (and what few possessions the family might have) as her community moves about. Other children must be old enough to keep up with the tribe as it moves, so they do not become a burden on the community. This reality dictates that children must be spaced about four years apart - something hunter-gatherer societies achieved through sexual abstinence, extended nursing, abortion, or infanticide. Farming societies, by contrast, stay in one place with their crops. Because mobil-ity of children is not a consideration, and because children can contribute to food production from an early age, fertility rates in farming communities are higher, often with birth spacing averaging only two years. All these factors contributed to higher popula-tion densities as human lifestyles shifted from hunting and gathering to farming.

As food production expands, certain members of society can be freed from producing food to do other things. Some become soldiers to guard that food. Some become administrators, and collect taxes to support those soldiers. Some become priests. (This is the point at which formalized religions emerge, and at which the priesthood becomes a social class.) And some become artisans and inventors, pushing the technological envelope with creations such as pottery, bronze, and the wheel.

As food surpluses mount, it becomes necessary to identify ownership of stored food, and writing systems develop. As social complexity increases, the demand for writing grows. Scribes are needed, as are schools and teachers to train them.

As civilizations expand, they develop legal systems, because once population reaches a critical mass, the type of social enforcement that serves to keep order in tribal groups becomes ineffective. Some sort of justice system - police, courts, prisons and executioners - must be created.

This combination of all these factors led not only to flourishing cultures, but also to unprecedented population growth. By the time of the First Dynasty in Egypt (circa 3000 B.C.E.), global population had grown to an estimated 100 million - 10 to 20 times the increase in human numbers over the preceding 2 million years. By the height of the Roman Empire and the birth of Jesus Christ, that number was perhaps 250 million - almost the size of the United States today.

As productivity increased - fostered by inventions such as the plow, pottery, ironwork and the water wheel, as well as a greater understanding of raising plants and animals - food supplies increased further. In response to available food supplies, human numbers increased again. More people then required more land for fields and towns, which in turn led to greater productivity and prosperity, and again to more people.

Impacts of Growth

As human numbers increased, both positive and negative impacts of growth became apparent. Larger populations contributed to greater military power through larger armies. More people stimulated economic growth due to increased numbers of producers and consumers. They pushed technological de-

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velopment because some people could be freed from producing food to become craftsmen and inventors.

Larger populations also provided sufficient labor to construct public works projects, such as fortifications, roads, and irrigation systems, as well as administrative centers and monuments. But larger populations also caused environmental destruction, forced migration, and conflict.

Civilizations typically arose and flourished due to the availability of resources such as fertile soils and good water, minerals for metalwork, or forests for fuel and shipbuilding. In the prosperous times that followed the exploitation of those resources, population tended to increase. That larger population then exploited the resource base to a greater degree.

At some point a threshold was reached, beyond which the resource base could no longer support the population. The resulting disruption then caused problems similar to those we see today from severe population pressures - social and economic turmoil, hunger, migration, and war.

As civilizations faced extreme resource scarcity, typically one of three things happened: they overran another civilization to secure new resources (and were often assimilated); or, in their weakened condition, they were overrun by another culture: or, they simply collapsed and their people dispersed. We can see this in our cultural birthplace in the Fertile Crescent, and the progression of civilizations that flourished and collapsed there - from Babylon, to the Hittites, to Assyria and to Persia. All of these societies committed what author Jared Diamond calls "ecological suicide."

The transition from nomadic lifestyles to agriculture and civilization as we know it began in three primary regions of the world - Southwest Asia, China, and Mesoamerica. But none of those areas could sustain the intensive agriculture necessary to support large populations, and all became increasingly degraded. Because of food scarcity, large numbers of people lived on the edge of starvation.

Resource scarcity also caused other impacts. As historian Gwynne Dyer wrote, "The basis of civilization is agriculture, which transforms the land into a valuable possession that requires protection." It is understandable then, that the first recorded war in human history was fought between two cities in the Tigris-Euphrates Valley over the movement of a boundary stone marking fields. To threaten a society's farmland was to threaten its food supply, which was to threaten its very existence.

Since that time, countless wars have been fought over hunting grounds, farmland, forests, water, salt, minerals, or control of strategic areas or trade routes. Underlying all of these conflicts were the greater needs of greater numbers of people.

Viewed through a demographic lens, the rise and fall of civilizations fits a similar pattern. The Hyksos conquest of Egypt around 1600 B.C.E., for example, is credited to their use of horses and chariots. But driving that conquest were population growth and resource scarcity, compounded by deforestation, desertification, and soil erosion in the Hyksos' original homelands in Syria and Palestine. When their traditional home could no longer support their population, the Hyksos seized the richest territory they knew of, which was Lower Egypt.

The expansion of the Greek Empire can be simi-

The Rise and Fall of the Fertile Crescent

The rise of highly organized and successful civilizations in the Fertile Crescent (in the fourth millennium B.C.E.) was due to a fortunate mixture of natural resources. Numerous plants and animals could be easily domesticated, including wheat, barley, peas, sheep, cows, and pigs. The area also possessed fertile soils and adequate water supplies for irrigation. But because of limits on soil area and depth, the larger populations that resulted from increased food production and prosperity soon overran the resource base. The need to feed ever-larger populations caused farmers to overwork and overirrigate their fields, resulting in depletion and salinization of the soil. Fertile Crescent societies initially responded by putting more land in production, and by shifting from wheat to barley (which is more tolerant to salt). These measures provided only temporary relief, however, and food shortages eventually undermined the civilizations. Initially the centers of power stayed in the Fertile Crescent, shifting in succession from Babylon, to the Hittites, Assyria and Persia. Power shifted west in the fourth century B.C.E. when Alexander the Great conquered all the advanced states from Greece to India. It shifted further west when Rome conquered Greece in the second century B.C.E. When Rome fell, the center of power moved again, to western and northern Europe. ". . . Fertile Crescent and eastern Mediterranean societies had the misfortune to arise in an ecologically fragile environment," writes Jared Diamond in Guns. Germs and Steel: The Fates of Human So-cieties. "They committed ecological sui-cide by destroying their own resource base."

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larly linked to population pressures. By 650 B.C.E., population had increased significantly in response to the prosperity brought by trading. Unfortunately, environmental destruction - primarily manifested as deforestation and soil erosion - also increased. Plato, in his *Crititas*, observed that, "What now remains compared with what then existed is like the skeleton of a sick man, all the fat and soft earth having wasted away, and only the bare framework of the land being left. . ."

The combination of population growth and environmental destruction meant that the supply of farmland - and therefore food - was insufficient to meet the needs of Greece. This stimulated Greek colonization of the forest and farmlands around the Mediterranean and the Black Sea.

The rise of Rome was also profoundly affected by increasing human numbers. The fledgling civilization fought its first major wars against the Samnites of northern Italy, who were forced by population growth down into the Roman province of Campania in search of farmland. After three major wars, the Romans prevailed.

They then employed their expanded and improved army to seize additional cropland, forest areas, and mineral resources all around the Mediterranean. With a larger population, a larger army, and a booming economy due to captured resources, Rome became the world's first great empire.

But population growth and the resulting environmental destruction also contributed to the fall of Rome. The constant need to feed more people, maintain standing armies and support a growing economy forced the Romans to overexploit their resource base.

Rome had guaranteed every citizen a daily ration of bread since 58 B.C.E. to assure political stability. To create fields to produce enough grain (and to provide construction and shipbuilding materials), forests were cleared around much of the Mediterranean. Deforestation and erosion worsened as fields were carved out on ever steeper slopes in an attempt to produce still more grain. Rome was forced to virtually abandon several major cities such as Leptis Magna, in what is now Libya, as erosion and climate change caused by deforestation destroyed their harbors and grain fields.

The Empire began gradually to contract as environmental destruction, outside military pressures, and internal dissent mounted. By the time the Roman capitol was overrun in the early fifth century C.E. by the Goths, the western Empire was only a shadow of its former glory.

Setbacks

Population growth was not always linear. Famine, war, or disease often decimated local or regional cultures. In fact, as population grew, another pattern

The Great Wall of China
and the Sack of Rome

Population pressures have always shaped human history. The connections are not always obvious, however, because they may be quite slow-acting. Consider how construction of the Great Wall of China ultimately led to the sack of Rome.

In the third century B.C.E., a civilization of nomadic warriors flourished in Mongolia. The Chinese called these people Hsiang-Nu, but in the west, they became known as the Huns. As their population increased, the Huns gradually moved south, and began to raid China.

The Chinese responded by building the Great Wall. The Huns continued to raid around the Wall, and the Chinese ultimately had to extend their defenses. They captured and fortified the Tarim Basin all the way to foothills of the Pamir Mountains. Unable to penetrate this barrier, the Huns were forced west into Central Asia.

A few centuries later, another group of nomadic warriors arose in Mongolia. The Chinese called these people the Juan-Juan, but modern historians call them the Avars. The Avars also raided south, were unable to penetrate the Great Wall, and were forced west.

In Central Asia, the Avars collided with the Huns. The Avars, with a major technological advantage (the stirrup, which makes fighting from horseback much more efficient), defeated the Huns and drove them further west. At the Dniester River, the Huns collided with the Goths, who were being held out of the Roman Empire by a combination of treaties, bribes, and Roman Legions. When the Huns fell on the Goths, they slaughtered them in great numbers, and drove the survivors across the river into Roman territory.

Once the Goths had penetrated the Empire, they found it an empty shell. They smashed through southern Europe, crushed the remaining Roman Legions, and sacked the capital in 410 C.E.

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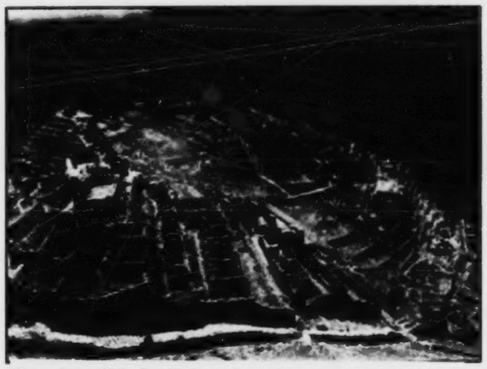
of human history emerged - natural and human-induced disasters that killed large numbers of people.

Historically, human numbers were greatly limited by disease. This was especially true as growing populations became more concentrated in cities, where people were more easily exposed to infectious agents. (It takes a minimum population for diseases to sustain themselves. Measles, for example, requires about 7,000 susceptible individuals to assure its survival. A regional population of from 300,000 to 400,000, with regular contact, is probably the minimum necessary to sustain that disease.)

Plague devastated Athens in 429 B.C.E., and large parts of China 200 years later. It ravaged the Roman Empire from 160 to 184 C.E., killed a large percentage of the population of Constantinople in 542 C.E., and reached Britain by 547. By the end of that cycle in 594, the population of Europe had been halved. Plague returned periodically, peaking in the fourteenth century, when it killed an estimated one third of the population of Europe.



The ruins of Machu Pichu in Peru: Diseases introduced by European invaders devastated the Inca and other native civilizations in the Americas.

Other diseases were equally devastating, if more localized. When Spanish conquistadors invaded Mexico in 1517, the native population was perhaps 25 million. In less than a century, it had fallen to just over one million due to introduced diseases, such as measles. In South America, the introduction of smallpox by Europeans damaged the Inca Empire so badly that Pizarro's few soldiers, horses, and guns easily toppled it.

Famine also slowed population growth, appearing regularly around the world from the earliest times of recorded history. The Near Eastern and Mediterranean worlds were always susceptible to famine, as indicated by Biblical references.

Famine was an integral part of Roman history, and closely linked to the final collapse of the Empire. As its population grew, and environmental destruction limited local productivity, the Empire became dependent on foreign sources of grain. As the Empire contracted - and grain producing lands in Germany, Egypt, and Britain were lost - Roman authorities were unable to provide the guaranteed distribution of food that had long maintained domestic stability. Between 400 and 800 C.E., the population of the city of Rome fell by over 90 percent, largely because of famine.

Large-scale famine also occurred in the Byzantine Empire in 927, in Japan in 1232, Germany and Italy in 1258, England in 1294 and 1555, all of Western Europe in 1315, Russia in 1603, Bengal in 1669 and 1769, Ireland in 1845-49, and China and India in 1876 and 1879. Tens of millions died in these events, sometimes reducing local populations by as much as one third or more.

Despite these setbacks, however, population continued to grow overall. By 1500, world population had reached an estimated 500 million. It was around this time that the era of western colonial expansion began in earnest, driven by the demands of more people for more resources.

The Age of European Expansion

Historically, shortages of farmland, water for irrigation, timber for construction and fuel, or minerals for manufacturing all limited population size and economic opportunities. Lack of work, economic instability, local food scarcity, and lack of available land also drove migration and conflict, as people competed for those resources.

But those effects tended, for the most part, to be localized. People migrated from country to city, and neighboring or regional civilizations clashed. So while the distribution of resources changed with the ebb and flow of cultures, the general availability of resources in any given region did not increase. The Europeans broke out of this pattern, however, when they began to conquer and colonize distant areas of the world.

The first Europeans to actively colonize other regions were the Vikings. The forces behind their expansion were complex, but scarcity of farmland was a key element. As historian J.M. Roberts wrote, "These Scandinavians combined trade, piracy and colonization, stimulated by land hunger."

The first known Viking raid occurred in 793 C.E., and over the next 400 years they discovered and settled the Faroe Islands, Iceland, Greenland, and parts of Newfoundland.

Moving east and south, the Vikings penetrated the heartland of Russia (which is named for the Rus, as the Vikings were called there) and founded city-states such as Kiev and Novgorod. They raided as far south as Constantinople and Baghdad, and threatened French cities to the point that they were given huge tracts of land in what is now Normandy ('land of the Northmen') in exchange for peace. And they conquered much of the richest farmland of Northern England and Ireland.

By the early 15th century, Portugal had begun to explore and exploit the West Coast of Africa. The wealth they captured created an economic and population boom at home, and stimulated further explorations. The Portuguese pushed down the coast of Africa, then eastward. They established trading colonies in India about the time Columbus reached the Caribbean, and launched the era of Spanish exploration and colonization.

While the early European empires were seen primarily as sources of wealth, the flood of resources they returned to Europe caused a profound shift. As expected, increased prosperity stimulated local population growth in Portugal and Spain. But new protein sources increased the ability of northern European nations to produce food, and their populations began to expand rapidly.

Less than 100 years after the introduction by the Spanish of the potato from South America and maize corn from Mexico, England and Holland had joined the scramble for overseas colonies.

This new burst of growth (world population grew as much between 1500 and 1750 as it had in the previous 1500 years) created renewed scarcities, particularly of farmland. Because of this, smaller nations such as England and Holland began to see colonies not only as a place to obtain resources *from*, but also a place to send excess population *to*.

This trend continued through the 19th century, with nations such as Germany, Sweden, and Norway, as well as British-occupied Ireland, also reducing population pressure through emigration to North America.

Conflict between nations intensified throughout the Age of Expansion, as competing powers fought over trade routes and access to resources in North and South America, Asia and Africa. But conflict also occurred on a more local scale, as the new arrivals clashed with indigenous populations.

As European settlers expanded across North America, for example, they displaced or dispossessed Native inhabitants. Those peoples were then forced to migrate, and subsequently displaced the tribes onto whose lands they were driven. If they failed to do so, they vanished as a culture.

As Americans pushed further west in search of more land and resources to supply a growing population, more clashes followed.

By the time the western edge of the continent was reached, the new immigrants controlled the majority of land and resources, and most surviving indigenous populations were relegated to reservations.

The Industrial Revolution and the Age of Science

World population growth continued through the nineteenth century at a high rate, spurred by a general economic expansion, and increased food production as new lands were opened up. Around 1830, human numbers reached one billion for the first time.

The Industrial Revolution generated a tremendous economic boom, as machine power made mass manufacturing possible. Steam-powered trans-

The Potato and the American Civil War

When Spain and Portugal began their colonial expansion, northern Europe was largely a backwater. Shorter growing seasons limited grain production, so the area lacked the caloric resources to undertake significant exploration and conquest.

But when Spanish explorers brought the potato back from South America, everything changed. Potatoes grew well in cooler climates, and provided lots of calories. With more food available, population increased rapidly in England, Holland, Germany, Poland and Sweden. When those countries faced shortages of farmland, jobs, and other resources due to population growth, they ex-perienced massive out-migration. Millions of those emigrants moved to the northern US.

Because of this influx, US population grew roughly 35% every decade from 1800 to 1860. This caused a huge demographic shift. In 1800, the South was home to half the US population. But by 1860, it represented just over one-third.

In 1847 the Union comprised 15 slave and 14 free states, so southerners maintained control of the US Senate. But as immigration fueled western expansion, new states began to arise. The South tried desperately to ward this off. It stonewalled the Homestead Act and the transcontinental railroad, because those would promote western settlement. And it attempted to create new states where southern institutions could flourish. In the 1840's and 50's, southerners led or sponsored three attempted invasions of Cuba, three efforts to seize Nicaragua, and one invasion of Baja California. They also tried to purchase the northern third of Mexico.

None of these efforts were successful, nor could they offset the relentless forces of population growth. By 1860, slave states were a minority, and political power had shifted north. By 1861, southerners knew they had only two choices: either surrender slavery, or fight (and win) a war of secession.

portation systems allowed people and goods to move easily from one place to another, while mechanization made it possible for fewer farmers to work more land. And the possibility of working for cash wages opened up opportunities to accumulate capital and to move it easily, whether for investment or migration.

Improved living conditions and an optimistic view of the future also contributed to increased birth rates in many areas. People in the past had sometimes limited family size due to resource constraints (often through abortion or infanticide), but they now began to have more children.

Just as birthrates in the US dropped during the Great Depression and rose after World War II (the "baby boom"), they peaked in Europe during times of peace and prosperity in the nineteenth century. French birth rates peaked after the Peace of Amiens in 1802. Russian birth rates peaked after the freeing of the Serfs in 1861. And German birth rates peaked after the formation of the Empire in 1871.

Health care clinic in Peru. When modern health care techniques were introduced in developing countries after WWII, death rates declined dramatically, while birth rates remained high. This is one cause of the "population explosion" since 1950. FAO Photo

Despite a subsequent drop in birth rates in the late nineteenth and early twentieth centuries - as more people moved to cities and larger families were no longer needed to work the land - population growth continued. Advances in medicine and sanitation lowered mortality and increased life expectancy. During the Civil War, health care workers demonstrated that steps as simple as doctors washing their hands between operations and sterilizing instruments dramatically reduced infection. Development of safe water sources, sewer systems, and food preservation technologies also improved health.

The work of Koch, Lister and Pasteur provided increased understanding of infectious agents, while the development of general anesthetics, Xrays, and corrective surgery saved countless lives. The invention of antibiotics, such as sulfonamides and penicillin in the 1930's, allowed treatment of many previously fatal infections, and vaccinations protected people against diseases such as smallpox, typhoid, and measles.

The Modern Era

After World War II, relief workers from the United Nations and other organizations introduced these public health measures to the less developed regions of the world. Without the historic constraints of hunger and disease, population growth in those regions has been dramatic - so dramatic that the term "explosion" has sometimes been used to describe it. In some regions growth rates reached three to four percent annually, which equates to a doubling of population every 17 to 23 years.

It took all of human history for population to reach one billion, but barely a century to reach two billion. The third billion was added in just 30 years and the fourth in only 15 years. Today, we're adding another billion people roughly every 12 to 13 years. If current rates of increase continue, world population will double again in just over 40 years.

The vast majority of this growth will occur in the developing world. Africa is growing at a rate that, if maintained, will lead to a doubling of population in under 25 years. While most demographers expect fertility rates to decline, South Central Asia is currently on track to double its population in 30 years, and Central America to double in 35 years.

The choices we make in the next few years will determine our demographic future. It is possible to stabilize population through just, humane, culturally-appropriate methods. We can do this by investing in reproductive health care, education, empowering women, poverty alleviation, human rights, and sustainable development. Or we can watch population spiral out of control until natural laws intervene - as they have throughout history.

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How Many People Can The Earth Support?

The Carrying Capacity Debate
Agreeing to disagree

The Larger Questions
How many, how much, how long

The Lifestyle Lottery
Which would you choose?

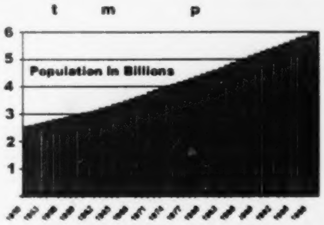
How Many People Can the Earth Support?

The dramatic increase in human numbers during this century has been cited by some as proof that the Earth is overpopulated. But the diversity of natural environments and human lifestyles around the world makes any definition of overpopulation highly subjective. What seems overcrowded in suburban America might be considered comfortable or even lonely in urban India, for example.

In seeking a better way to determine sustainable levels of population and development, some scientists have begun to look at the Earth's "carrying capacity." This is generally defined as the number of individuals the planet can support indefinitely. The problem with this, however, is that there is a lack of scientific data, and therefore no consensus as to how many people the Earth can support. (In 1994, estimates of sustainable population ranged from less than 3 billion to over 44 billion.)

As cities continue to grow, so do the problems caused by crowding, pollution, and crime - all byproducts of the kinds of pressure that population can put on the places people live.

Some individuals - mainly biologists and environmentalists - argue that human numbers have already exceeded the Earth's carrying capacity. They point to the growing rate of extinction of species, global climate change, and more people living in poverty than ever before as indicators of this. Others - mainly economists - argue that the planet can sustain an almost infinite number of human beings. More people provide more brains to figure out how to increase carrying capacity, they contend, and cite such things as the "green revolution," increased energy efficiency, and increasing longevity to support that argument.



Data from the U.S. Census Bureau
Graphic by Facing the Future

The Carrying Capacity Debate

The "pro growth" or "free trade" faction - typified by the late economist and author Julian Simon of the University of Maryland - essentially believes that natural resources are not finite in an economic sense. Any scarcity is temporary, they argue, until price increases spur efforts to discover new sources of raw materials, and new technologies to extract and process them.

In fact, Simon contended, consumption of resources is actually beneficial because it stimulates their production. Rather than trying to stabilize population or lower consumption, he said, we should focus on economic development, production, and consumption. Simon cited increased life expectancies, global economic growth, and lower price trends for energy as indicators of success.

The "sustainable" faction - represented by environmentalists such as Lester Brown, president of Worldwatch Institute - argues that many essential stocks of renewable resources are already in decline, and that technology alone cannot reverse these declines.

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Carrying Capacity and Sustainability

Carrying capacity is defined as the maximum population a given ecosystem (or planet) can support without jeopardizing its ability to support future generations. Sustainability, or sustainable development, essentially means that economic systems should meet the needs of existing populations without endangering or stealing from future generations. It means that consumption must be balanced with the rate at which the eco-system can renew resources. And it means that disposal of wastes must be balanced with the ability of natural systems to absorb or neutralize them. The carrying capacity of any given ecosystem is dependent upon:

- **the size of the population within the system**
- **the per capita economic activity and resource consumption of that popula-tion**
- **the technology used to support that activity and consumption and dispose of wastes**
- **and the susceptibility of the ecosystem to damage**

It is possible to exceed carrying capacity through overpopulation, overconsumption, or the utilization of destructive or inap-propriate technologies. Any combination of these variables can also exceed the carrying capacity of a given system. Thresholds of damage will be lower in fragile ecosystems (meaning carrying capacity is more quickly exceeded because the environment is easily damaged), while more robust eco-systems may withstand higher levels of population and consumption.

The consequences of any species exceeding the carrying capacity of its environment is a "die off" until the population is brought back within sustainable limits. Because the cumulative damage inflicted by overpopulation, overconsumption, or destructive technologies also reduces carrying capacity, the die off is likely to be catastrophic.

Brown points out that in many parts of the world, forests, aquifers, pasture lands, and fisheries are being utilized faster than they can be replenished. Despite the green revolution, he notes, world grain carryover stocks, and therefore global food security, remain near record low levels. And despite half a century of unprecedented economic growth, nearly one quarter of the world's people live in extreme poverty.

Both sides in the debate agree on many of the underlying facts. Since 1950, the world's population has more than doubled, and its economic output has increased almost sixfold. In that time, world water use, and demands for grain, firewood, beef and mutton have tripled, and fossil fuel use has nearly quadrupled. But they disagree on the impacts and benefits of those trends.

Simon, in his books *The Ultimate Resource* and *The Ultimate Resource 2*, pointed out that per capita energy costs have fallen in the last half of this century due to demand driving production. He argued that resources are not truly in decline, and cited as evidence relatively modest increases or even significant decreases in commodity prices.

Simon also argued that concerns about rapid rates of species extinction are vastly overstated, and that global warming and ozone depletion are less threatening than many perceive them to be. Population growth is positive, he believed, because more people means more human intelligence can be focused on solving problems.

But Brown charges that low energy costs do not include "externalities" such as the loss of salmon runs due to hydroelectric dams, spills from oil tankers, or acid rain from coal and oil-fired power plants. He also notes that many commodity prices are artificially suppressed by government subsidies for large energy, forestry, mining, and agribusiness interests. Brown wrote in the Worldwatch publication, *State of the World 1998*, "While economic indicators such as investment, production and trade are consistently positive, the key environmental indicators are increasingly negative. Forests are shrinking, water tables are falling, soils are eroding, wetlands are disappearing, fisheries are collapsing, rangelands are deteriorating, rivers are running dry, temperatures are rising, coral reefs are dying, and plant and animal species are disappearing. The global economy as now structured cannot continue to expand much longer if the ecosystem on which it depends continues to deteriorate at the current rate."

The Larger Questions

What's missing in this debate is any agreement about the specifics of the question. Before we can determine how many people the Earth can support, we have to answer the question, "What do we mean by support?" Does it simply mean the ability to feed, cloth and house people? If so, we must also ask, "At what standard of living? For what percentage of the population? And for how long?"

For example, could the current global population of nearly six billion all live an American lifestyle indefinitely? If we consider that with under five percent of the earth's population, Americans use roughly one quarter of all energy and fossil fuels, one third of all paper, one fifth of all metals, and generate almost three quarters of toxic waste worldwide, the answer seems clearly to be no.

If the Earth cannot support its current population at a typical American standard of living, then two basic possibilities emerge. One is that everyone could live a less intensive lifestyle - eating less animal protein, consuming less energy, living in smaller homes, and having fewer consumer goods. The other is continued inequity between rich and poor nations and individuals, with a few living high-impact lifestyles, and most people living a minimal existence.

Either possibility has severe economic, social, and security implications. Either possibility would also have to include the reality of several billion more people on Earth in the next 50 years.

What Lifestyle Would We Choose?

If carrying capacity is defined as the maximum population the earth can sustain without reducing its ability to support that population in the future, further questions arise. Is physical support enough for human beings, or do we also need social and spiritual support? Is there a difference between "biophysical" carrying capacity and "social" carrying capacity?

It is theoretically possible for people to survive in a world that consists of only water, shelter, and grain. But would we want to? Could we live in the "virtual" world forecast by some "futurists", in which people barricade themselves inside against the outside threats of crime and pollution? Or do we need access to real parks and playgrounds, real wildlife and wilderness, and silence and solitude in nature?

If population continues to grow unchecked, there is also the question of how (or how long) our social structures will survive. Scientists have long recognized that crowding itself is stressful. Depending upon social and cultural contexts, manifestations of that stress include increased levels of crime, communal violence, drug abuse, civil unrest, and war.

We also need to ask how many people can the Earth support with what kind of political institutions? Democracies may not deal with resource scarcity and conflict as effectively as authoritarian regimes. There is already a trend away from democracy, and toward "hard" regimes in many areas where population growth, poverty, resource scarcity, and environmental degradation threaten social stability. In parts of Africa, Asia, Latin America, and the former Soviet Union, authoritarian regimes have come to power (or existing regimes have become more authoritarian) as a response to these destabilizing influences. If democracy is our preferred form of government, the social carrying capacity of the planet may be lower than it would under dictatorships.

Refining the Question

How many people can the Earth support:

- **At what average level of well-being?**
- **With what distribution of material well-being?**
- **With what technology?**
- **With what kinds of domestic and international political institutions?**
- **With what domestic and international economic arrangements?**
- **With what domestic and international demographic arrangements?**
- **With what physical, chemical and biological environments?**
- **With what risk or robustness?**
- **For how long?**
- **With what values, tastes, and fashions?**

From the article "How Many People Can the Earth Support?" in the January 1996 "Population Today," by Joel Cohen

As the world becomes more crowded, the question of how we will respond to these increasing stresses becomes much more critical. Despite the end of the Cold War, some 30 wars and dozens of deadly local conflicts currently rage around the planet. As more people compete for diminishing resources - and as environmental destruction exacerbates those scarcities - security experts foresee the potential for greater conflict.

This may generate a devastating cycle in which more and more resources and technology are committed to preparing for and engaging in conflict, and fewer resources are available to support the needs of the population. The resulting increase in stress and scarcity then promote even greater instability and conflict.

In short, the answer to the carrying capacity debate is dependent upon the choices we make about our personal reproduction, our lifestyles and consumption, and our political, economic, and social priorities. As Paul and Anne Ehrlich noted in *The Stork and the Plow*, "Earth can support a larger population of cooperative, far-sighted, vegetarian pacifist saints than of competitive, myopic, meat-eating, war-making typical human beings. All else being equal, Earth can hold more people if they have relatively equal access to the requisites of a decent life than if the few are able to monopolize resources and the many must largely do without. The problems of population, social and economic inequity, and environmental deterioration are thus completely intertwined."

Tracking the Trends

On the Way to 14.4 Billion?
Population trends and possible futures

Feast and Famine
Trends in food security

A Very Thirsty Planet
Trends in Water Availability

The Wealth and Poverty of Nations and People
The widening gap between rich and poor

Scarcity and Security
As resources dwindle, problems escalate

And the Good News Is . . .
How we can choose a positive future

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While the debate continues about how many people the Earth can support, several important indicators of human well-being appear increasingly negative. We are clearly consuming resources and producing waste at rates beyond the earth's carrying capacity, and generating greenhouse gases faster than the atmosphere can recycle them.

Because of population growth, critical renewable resources such as arable land and fresh water per-person are declining, as are forested area and fish catch. The gap between rich and poor is growing wider, and more people are falling into poverty every day.

Despite a general decline in fertility rates, world population is still growing rapidly. It will double in just over 40 years if present trends persist, and could reach 14.4 billion in 2050.

When population increases, the availability of key resources per person declines. Resource scarcity - compounded by environmental destruction and unequal distribution - fuels a number of other problems. It drives poverty, discrimination, greater environmental destruction, migration, and conflict.

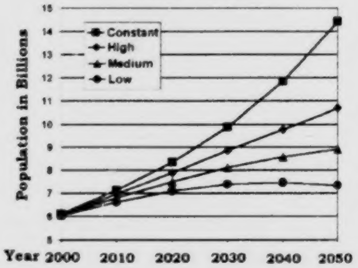
In reviewing these trends, it's important to remember that, while they are dangerous (and even frightening), we do know how to correct them. We can stabilize population. We can assure food and water security for all. We can end poverty and create an equitable, sustainable economy. To do so, however, requires first that we recognize the extent and implications of these trends, and that we work together to reverse them. The "Solutions" section later in this guide explains in greater detail how we can do that.

Population Trends

The latest estimates and projections by the United Nations (released in the fall of 1998) indicate that world population growth rates have declined somewhat from peak levels in the late 1980's and early 1990's. This is primarily due to declining fertility in parts of the developing world as a result of improved economic and social conditions, and reproductive health efforts.

Unfortunately, it is also due partly to increasing numbers of deaths from hunger, AIDS and other infectious diseases, and casualties in regional and local conflicts.

World Population Projections 2000 - 2050



Data from United Nations,
"World Population Prospects 1998"
Graphic by Facing the Future

Despite this decline, however, world population is currently growing by about 80 to 85 million people each year. This is roughly the equivalent of adding another Germany every year, another Spain every six months, or another San Francisco every 80 hours. This growth is a result of natural increase, declining mortality, and increased longevity.

Natural increase is defined as a surplus of births over deaths in a given period. According to the Population Reference Bureau's 1999 World Population Data Sheet, world birth rates currently average 23 per 1,000 population, and world death rates average 9 per 1,000 each year.

Birth rates vary by region from a high of 46 per 1,000 in Middle Africa to a low of 9 per 1,000 in Eastern Europe. The higher birth rates in populous regions like Africa (39 births per 1,000) and South Central Asia (29 births per 1,000) are one reason population growth is projected to remain high despite an overall decline in fertility.

Declining mortality - demonstrated best by lower Infant Mortality, because infants are most susceptible to malnutrition and disease - has somewhat offset falling birth rates. Worldwide, the Infant Mortality Rate (IMR) has dropped from 156 infant deaths per 1,000 births in 1950, to 57 in 1999. This is a very positive trend, and an important indicator of improving global health. But it also contributes to population increase in the short term. (Infant Mortality varies widely by region and affluence. It ranges from 150 deaths per 1,000 births in Western Sahara and Afghanistan, to a low of 3.6 deaths per 1,000 in Sweden and 3.7 in Japan. IMR in the US is 7 per 1,000, but rates are higher among some minorities.)

FAO photo

In August of 1999, the population of India reached one billion, almost triple the nation's population when it achieved independence in 1948. India's is currently growing by about 1.6 percent each year, and is expected to become the world's most populous country in the next few decades. By itself, India is expected to have more people than of all of the industrialized world (excluding Russia) by 2016.

Since achieving independence, India has made some notable gains. It increased life expectancy by some 60 percent (from 39 to 63 years) and lowered total fertility by almost half (from 6 children per woman to 3.1). Poverty rates have also declined, but because of population growth, the World Bank reports that the actual number of people living in poverty continues to rise.

With a population density already more than double China's and 10 times that of the US, India suffers from deforestation, soil erosion, water shortages, air and water pollution, and declining biodiversity. India also has ongoing boundary disputes with China and Pakistan, and, like those countries, possesses nuclear weapons.

India has long struggled to reduce population growth, but as a democracy, it has generally avoided the harsh measures adopted by neighboring China. The future stability and prosperity of India will depend upon its ability to stabilize population. Some states, such as Goa and Kerala, have achieved below replacement fertility and high levels of social health through investing in family planning, education, and health services. Others have chosen to invest in rapid industrialization, and still have rapidly growing populations.

Increased longevity also contributes to population growth in the short term. Because more people are living longer, the balance between births and death has shifted. In 1950 the ratio of births to deaths was roughly 37 to 20 per 1,000 - a margin of under two to one. Today, the birth rate has come down to 23 per 1,000, but the death rate has fallen to 9 per 1,000 - a ratio closer to two and a half births for every death.

This is partly due to the fact that the world's population is younger, on average. But it is also due to an increase in average life expectancy, which rose from 46 years in 1950 to 66 years in 1999. Again, this is a positive indicator of improving global health, but it also contributes to higher population levels. (Longevity, like Infant Mortality, varies widely by region. Life expectancy in much of Sub-Saharan Africa is actually declining due to AIDS and wars, and now averages only 49 years. It is down to 36 in Malawi, 37 in Zambia, and 40 in Botswana and Zimbabwe. Western Europe and the US, by contrast, average 77 years. Life expectancy in Japan is 81 years, the highest in the world.)

The other major factor in continuing population increases is population momentum. Even if replacement fertility were achieved immediately - which is extremely unlikely - just over one half of the world's population is now under age 25. As those three billion people, most of whom live in developing regions, raise families over the next three decades, world population will continue to grow by another billion every 12 to 13 years.

Growth of that magnitude exerts severe demands on natural, social, and economic systems. Growing populations require more infrastructure, more services, and more room, as well as more jobs and more resources. If natural, social, and economic systems cannot provide those things in sufficient quantities, the result is likely to be increased poverty, social disintegration, and civil unrest.

On an even more basic level, 80 to 85 million new people every year require the minimum essential needs of adequate soil to produce food, and water to drink and wash in. Without adequate supplies of food and water, it matters little whether we have enough oil, gold, schools, or jobs. And despite significant advances in food production during the last half of this century, the trend of available food per person is downward.

Trends in Food Security

The "Green Revolution" dramatically raised per capita availability of food. Application of modern farming techniques expanded food production - es-

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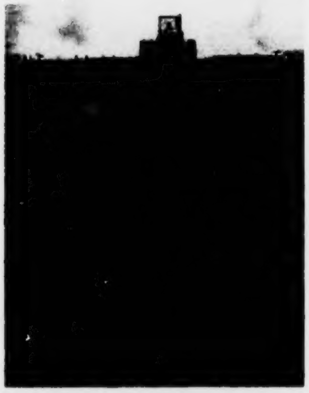
pecially grain production - faster than population growth in the 1950's through 1970's. Total food calories available per person are higher today than 30 years ago, and fewer people are engaged in producing that food.

Despite some assumptions that such trends in food production will continue, however, the Green Revolution appears to have been a one-time gain. Since the mid-to-late 1980's, grain yields per acre and total production have declined on a per capita basis. (Grain is a key indicator because it constitutes the majority of the human diet, whether directly as bread or rice, or as feed for beef, pork or poultry.) Even a record world harvest in 1997 - attributed to favorable weather conditions, planting land previously set aside in conservation programs, and shifting production from other crops - failed to significantly rebuild world carryover grain stocks from historically low levels.



As Norman Borlaug, the "father" of the Green Revolution, pointed out, it is not the solution to world food needs. During his acceptance of the Nobel Peace Prize in 1970, Borlaug warned that advances in agricultural technology and production had achieved only "temporary success." The result, he said, was merely to buy the earth another three decades to solve the problem of overpopulation.

The possibility of a new Green Revolution seems unlikely today, because most of the necessary ingredients are lacking. The huge spurt in production during the 1950's through 1970's was largely created through the application of modern farming techniques and increasing cultivated area. At the beginning of the Green Revolution, pesticides, chemical fertilizers, mechanization, hybrid plant species, and irrigation were available as "off the shelf" technologies. They already existed and only needed to be applied. Today, insects are increasingly resistant to pesticides, and yields have declined relative to increased fertilizer applications, Few new higher-yield plant species have been successfully developed and distributed, and water shortages have limited irrigation options.

Expanding agricultural operations into new areas is also a limited option today. The best land is already in production, and significant amounts of that acreage have declined in productivity or been converted to other uses. This, combined with population growth, has caused a steady decline in arable land per person since 1960.

Modern farming techniques have lessened soil fertility in many areas due to compaction, less fallowing, and salinization from over-irrigation. Because farming operations were often expanded into areas of thin soils or onto slopes subject to erosion, many areas also experienced significant top-

Farmland Loss in America

"The long-term implications (of farmland loss) are troubling. In 50 years, the population in the United States could increase 50 percent to more than 390 million with farmers and ranchers having to make do with 13 percent fewer acres of high quality farmland. In the worst case scenario, within the next 60 years, the United States could become a net food importer instead of a net food ex-porter. Regardless of whether this is true, the loss of open space, wildlife habitat, groundwater recharge areas and other benefits attributable to farmland are reason enough for our country to develop its land in a more efficient manner, directing development onto land less suitable for growing food and fiber.

American Farmland Trust concludes the following:

- **America is destroying farmland inevery state.**
- **The United States is squandering its best quality and often irreplaceable farmland.**
- **The patterns of urban development are scattered and fragmented, thereby increasing the pressures on farmland beyond those acres actually lost.**
- **By converting some of its best farmland to urban uses, the United States is limiting future options to deal with social, economic, food security and environmental problems.**
- **Efforts in the United States to manage land have, for the most part, failed to protect farmland.**
- **To date, the vast land resources in the United States have masked the most negative effects of farmland destruction.**
- **Conflicts are now escalating over varied uses of the nation's land resources.**

From "Farming on the Edge," by A. Ann Sorensen, RichardP. Greene, and Karen Russ, American Farmland Trust Center for Agriculture in the Environment, Northern IllinoisUniversity, 1997

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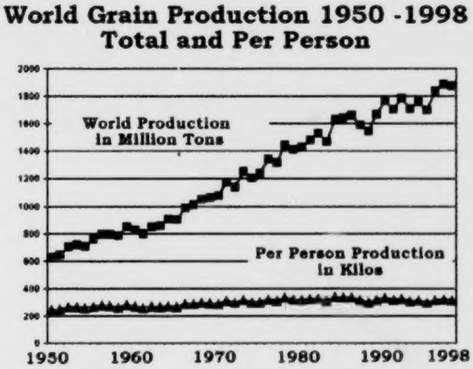
soil loss. Other areas suffered desertification.

In the past 50 years, an area greater than the size of India and China combined has suffered moderate to extreme soil degradation due to destructive land use practices.

Impacts of intensive agricultural practices on the natural environment have also been substantial. These include significant habitat loss as woodlands have been cleared, prairies plowed, and wetlands filled to create farmland. Pesticide and fertilizer applications and resulting runoff have endangered human health in many areas through water pollution, and reduced or destroyed native populations of plants, animals, insects, and microorganisms.



While world grain production has risen steadily, per capita production has fallen since the mid to late1980s due to population increase. Data from WorldWatch

Depletion of lakes, rivers, and streams through dams and diversions for irrigation has also led to the decline of species in those habitats. And increased methane emissions from fertilizer applications, as well as large-scale production of meat animals contribute to global climate change.

Conversion of farmland to residential and commercial uses, driven by population increases, is now occurring at an alarming rate. As nations grow and become more developed, farmland is often paved over to produce housing, industrial parks, shopping centers, highways, and parking lots. Since 1957, due to a combination of increasing population and conversion of farmland, China has seen its arable land per person fall by over one-half. In the US, we currently pave over an area the size of Delaware every year, just to accommodate our growing population.

Because of the combination of factors listed above, there has been no significant increase in global grain production this decade. Since 1990, however, world population has increased by over 700 million people. (1997's world record grain harvest was only 6.7% above 1990 levels, and the 1998 harvest was slightly smaller. During that same period, population increased by 13%, so the per capita availability of grain declined more than 5% overall.)

Despite all improvements in technology and production, some 300 million people - a number equal to the current population of the United States - have died of hunger-related causes since 1970. Optimistic forecasts by the World Bank and others have to date proven unfounded, and some observers argue that even existing levels of production will be difficult to maintain under current conditions.

It does not appear that shortfalls in grain production can be made up by other food sources, at least in the near term. Despite another world record fish catch in 1996, the amount of fish available per person did not increase because of population growth. Nor are current wild catch levels sustainable. According to the United Nations Food and Agriculture Organization, virtually all major world fisheries are being harvested at or over capacity. And because many high-value species such as salmon, cod, and tuna have already been depleted, much of the total catch is now

Fish Wars

Fish currently make up 16 percent of human diets worldwide. Most of the stocks that provide that nutrition, however, are in peril. According to the United Nations Food and Ag-riculture Organization, nearly three-quarters of the world's major fisheries are currently fished at or over capacity. Nearly three- quarters of the world's major fish species are Also being harvested at or over capacity. As more people compete for food sources and as harvesting those sources increases in economic importance scarcity induced conflict over marine resources is on the rise.

Today, "fish wars" are common in most of the world's oceans. As Greenpeace reported to the UN conference on high seas fisheries in 1995, "Tuna wars in the Northeast Atlantic, crab wars in the Northeast Pacific, squid wars in the Southwest Atlantic, salmon wars in the North Pacific, and pollock wars in the Sea of Okhotsk are all warning signs that fish stocks are in serious trouble."

More localized fish wars over specific fisheries include those between Norway and Iceland, Canada and Spain, Argentina and Taiwan, and Indonesia and the Philippines. In the Northeast Pacific, legal and verbal battles over declining salmon stocks occur regularly between the US and Canada, Alaska and British Columbia, Washington State and British Columbia, Treaty (Indian) and non-Treaty fishers, and sport and commercial fishers.

Fishing fleet in Madras, India. FAO photo.

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made up of lower value species such as squid, sharks, and skates.

Young water carrier in Ethiopia: Some 80 countries face water shortages today. FAO Photo

Aquaculture, or "fish farming," has significantly boosted the total world fish harvest in recent years. In 1997, it accounted for over 23% of the total world harvest. Most of that growth was in China, however, and the product did not reach world markets.

Finfish aquaculture relies primarily on feed made from grains and ground fish "meal." With static or declining per capita availability of grain and fish products, fish farming will have to compete for those resources with other sectors of the economy. Shellfish aquaculture, while not dependent on outside food sources, requires abundant, clean, nutrient-rich water, and is highly susceptible to pollution. Some aquaculture operations also create new problems through water contamination and habitat destruction.

Meat production, such as: beef, pork, mutton, and poultry, has grown dramatically, expanding more than four fold since 1950. This is due to higher demand, as more people around the world have adopted a more protein-rich diet, and to more intensive production techniques.

Continued gains, however, will require more grain and/or grazing land. But world grain production is declining relative to population, and overgrazing has already damaged large tracts of land. This explains why production increases have slowed this decade, and why some observers predict that increased meat production will not be sustainable. Meat is also likely to become more expensive and therefore less available to poor people.

According to studies by the United Nations Food and Agriculture Organization, the world will need to increase food production by more than 75 percent by 2025 to feed our additional population.

Trends in Water Availability

Equally as important to human survival as food, water is also becoming less available. Much of the increased production during the Green Revolution, especially in grain yields, was due to irrigation projects, and the pumping of "fossil" aquifers. (It takes 1,000 tons of water to produce a ton of grain.) Now many of those aquifers - which are underground reservoirs created during earlier geologic eras, and which recharge only minimally from precipitation - have been significantly depleted.

The water table of the Ogallala Aquifer, which supplies about 30 percent of all groundwater irrigation in the US, has dropped more than 30 meters in some areas. Some of the more shallow areas underlying America's High Plains have already been pumped dry. This explains why irrigated area in Texas has declined by almost one third over the last two decades, and why agricultural production in north and west Texas has fallen significantly.

In northern China, groundwater levels are dropping as much as one meter per year. This is a particularly ominous indicator in a nation where more than 300 cities already lack adequate water supplies.

Water Wars

Nearly 40 percent of the world's people live in river basins shared by more than two countries, and few areas of the world are exempt from increasing tension over water resources. In Asia, India and Bangladesh squabble over water rights to the Ganges River, while the nations that border the Amu Dar'ya and Syr Dar'ya withdraw so much water that the Aral Sea is going dry.

In Africa, more than 57 river and lake basins are shared by two or more countries. In the south, Namibia and Botswana depend on water from the Okavango to meet the needs of their rapidly growing populations, but withdrawals threaten the Okavango Delta, one of the richest biological preserves in the world. (Both nations, already extremely poor, are engaged in military build-ups to protect their share of that water.) In the north, Egypt's very existence is dependent on water from the Nile, which it shares with eight other countries.

In the Middle East – where population growth rates are among the highest in the world - Israel, Jordan and the Palestinian Authority struggle for larger shares of the Jordan River, and declining groundwater resources. To the north, Turkey is embarked on a massive dam-building project that could jeopardize water supplies in Syria, Iraq and Iran.

And in North America, Mexico and the US compete for the waters of the Rio Grande, while Colorado, Utah, Arizona and California - some of the fastest growing states in the US - all depend on water from the Colorado River.

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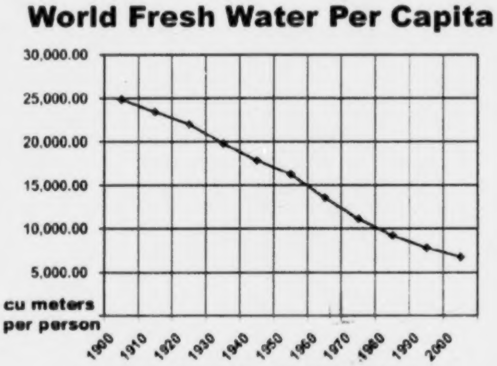
This situation is likely to worsen as population growth sends more people from the countryside to cities in search of work, and urban demands for water increases further. Water is so scarce around China's capital, Beijing, that farmers were prohibited from using local reservoirs for irrigation in 1994.

Many river systems are severely depleted as well. Because of dams and diversions for irrigation and industry, such great rivers as the Nile, the Ganges, the Huang He, and the Colorado sometimes run almost dry before reaching the sea. As a result, the eco-systems and fisheries they once supported are in decline. This threatens not only the economic survival, but also the physical health of local communities.



Data from US Census Bureau and "Sustaining Water" by Robert Engleman and Pamela LeRoy, Population Action International graphic copyright Facing the Future, 1999

The amount of fresh water available each year is relatively the same due to the hydrologic cycle. This natural system evaporates water over the oceans and condenses it into precipitation, which falls back to earth. Of that precipitation, about 70 percent evaporates again, and another 20 percent runs off in floods. The remaining 10 percent percolates into the ground, and supplies lakes, rivers, wetlands, and biological systems. Because the amount of retained water remains relatively constant, population increases mean there is less water available per person. In fact, due to rapid population growth, worldwide water supplies per person have declined by about one-third since 1970.

Some 80 countries already suffer from water shortages to some degree, and in more than two dozen of these countries, shortages are severe. Because many countries facing water scarcity also are experiencing rapid population growth, that scarcity is projected to intensify. A study by Population Action International predicts that - depending on population growth rates - between three and seven billion people may be living in water-stressed or water-scarce nations by 2050. This helps explain why the US State Department identifies several areas of the world where the potential for internal and/or cross-border conflict over water is high.

(Water stress is defined as an annual availability of less than 1,667 but more than 1,000 cubic meters of water per person. Water scarcity is defined as an annual availability of less 1,000 cubic meters of water per person. The United States is projected to have over 9,000 cubic meters of water available per person annually, but because of unequal distribution, numerous communities across the nation have experienced water shortages in recent years.)

Trends in Economic Equity

One other key trend is personal income and economic equity. This is especially important because, as societies become more developed and urbanized, people must purchase essentials such as food, water, and shelter rather than producing their own. Like trends in food security and water availability, trends in economic equity are in decline.

Since 1950, Gross World Product (GWP) has increased by almost six times - a fact that is highly desirable from an economic perspective. During that same period, however, because of population increases, per capita GWP has increased only two and one half times. Further, because per capita GWP is determined simply by dividing GWP by population, it does not reflect the growing gap between rich and poor.

Since 1960, the gap between rich and poor has increased from 30 to one to over 78 to one. In 1998, according to the United Nations development Program, the richest 20% controlled 86% of world income, while the poorest 20% controlled only 1.1%. The richest 225 people controlled as much wealth as the poorest 2.5 billion people. And the richest three people controlled more wealth than all the least developed nations and their 600 million people.

Due to a combination of population growth, structural issues, and that increasing disparity, the United Nations Development Program estimated in 1999 that more than 80 nations have lower per capita incomes than 10 or more years ago. In 55 countries, mostly in Sub Saharan Africa, Eastern Europe, and the Commonwealth of Independent States, per capita incomes are still going down.

Summary

In tracking the key trends of population increase, food, water and economic security, an ominous overall trend appears - increasing scarcity of key resources. (Population-induced scarcity takes two forms: environmental scarcity and structural scarcity. The former is defined as decreased supply resulting from environmental degradation such as cropland erosion and aquifer depletion, and/or increased demand due to more

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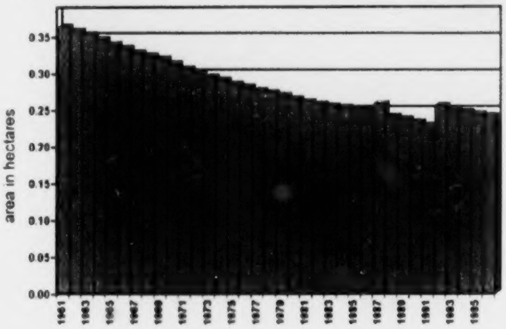
people in need, or greater per capita consumption. Structural scarcity results from unequal distribution of resources, such as the concentration of wealth among a few individuals while the larger society remains poor.)

Worldwide, arable land, grain production, fish catch, forested area, and fresh water are all declining on a per person basis. Both within and between nations, the rich are getting richer and the poor are getting poorer. This increasing scarcity is in turn linked to environmental degradation, declining social health, internal and international migration, and civil and trans-boundary conflict, as people struggle to maintain their standards of living, or even survive.

In brief, rapidly increasing population - combined with higher consumption lifestyles on the part of a growing number of nations - underlies virtually all of the critical issues we confront. They work as part of a dangerous "feedback" loop, in which more people consume and deplete more resources, which inflicts more environmental damage, which further increases scarcity. This is multiplied by inequitable distribution - cause both by discrimination and poverty, because poor people can't afford to pay high prices for scarce resources - and results in greater poverty, social fragmentation, increased environmental damage, greater migration, and higher-intensity social and political conflict.

World Arable Land Per Person



Source: World Bank World Development Indicators 1999
graphic copyright Facing the Future, 1999

And Now the Good News

There is an old Chinese proverb that says, "If you don't change course, you'll end up where you're headed." When examining these key trends, it's essential to remember they are only trends. They do not have to continue. We can change them. We have the knowledge, the technology, and the capital to do so. But we have to make that choice.

We know that fertility has declined significantly over the last 50 years, and we know why: better access to reproductive health care; higher levels of education; enhanced rights for women; and greater economic opportunities for many people.

But we can and must do more. Hundreds of millions of couples still do not have access to reproductive health care and cannot, therefore, reliably and affordably choose the number and spacing of their children. Hundreds of millions of children around the world either are not in school, or drop out at very young ages to help support their families. Social and economic customs discriminate against and disenfranchise women. And all too often, vital decisions are made only on the basis of short-term profit, without regard for long-term environmental or community impacts.

All of these factors interact to drive increasing population growth, scarcity, and poverty, which in turn drive migration, conflict, and environmental destruction. But all of these problems can be solved in just, sustainable, incentive-based ways. Individuals can and do make a difference every day. As "Scoop" Nisker used to say, "If you don't like the news, go out and make some of your own." Visit our "Solutions" section later in this Guide to see how we can all make a difference.

Population and the Environment

Environmental History
Early days, early damage

Modern Impacts – Falling Forests
For survival, for profit, for fashion

Killing Creation
As population increases, habitat decreases

The Air Up There
Smog, acid rain, global warming

There's Still Time
Saving the environment and the economy

As we approach a new millennium, human impacts on the natural world are becoming both more apparent, and more widespread. Almost 40 percent of the Earth's land surface has been converted to cropland and permanent pasture. Half the planet's tropical forests have been destroyed or degraded. Both fresh and saltwater ecosystems have been significantly damaged by chemical runoff, sewage discharge, and oil spills. The ozone layer has suffered substantial damage. Record-high carbon emissions cause smog and acid rain, and contribute to global warming and climate change. And an estimated three unique plant and animal species go extinct every hour.

At the heart of these problems are both our rapidly growing population, and the unsustainable, high-consumption lifestyles some of us choose to live. While more people in the developing world make demands on the environment to assure basic survival, wasteful consumption habits in the industrialized world - especially in the United States and Canada - use up critical resources, and leave behind a toxic residue.

The Environment and Global Security

"It is time to understand 'the environment' for what it is: the national security issue of the early twenty-first century. The political and strategic impact of surging populations, spreading disease, deforestation and soil erosion, water depletion, air pollution, and, possibly, rising sea levels in critical, over-crowded regions like the Nile Delta and Bangladesh — developments that will prompt mass migrations and, in turn, incite group conflicts — will be the core foreign-policy challenge from which most others will ultimately emanate, arousing the public and uniting assorted interests left over from the Cold War. In the twenty-first century water will be in dangerously short supply in such diverse locales as Saudi Arabia, Central Asia, and the southwestern United States. A war could erupt between Egypt and Ethiopia over Nile River water. Even in Europe tensions have arisen between Hungary and Slovakia over the damming of the Danube, a classic case of how environmental disputes fuse with ethnic and historical ones."

From "The Coming Anarchy," by Robert Kaplan, The Atlantic Monthly, February, 1994.

A Brief History of Population and the Environment

The destruction of local ecosystems by human beings is neither new nor uncommon. From very early times, people have inflicted significant impacts on the environment. Intentional burning of the savannas of Africa began at least 50,000 years ago. Clearing of forests began in New Guinea some 30,000 years ago. And burning of forests to create habitat for red deer began in Britain soon after the end of the Ice Age.

Extinction by hunting societies of "megafauna," or large mammal species, occurred on a vast scale in North and South America, and Australia. Well before European contact, an estimated 86 percent of large species had vanished in Australia, and roughly 80 percent of large mammals in South America had disappeared. In North America, two thirds of the large mammals present when the first humans arrived became extinct.

Some of this was due to climate change, as the end of the Ice Age caused a vegetation shift from tundra to forest. But Stone Age hunters devastated the surviving species. Three genera of elephants (including the Woolly Mammoth) disappeared, along with six of giant edentates

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(sloths and armadillos), 15 ungulates (hoofed mammals), and numerous giant rodents and carnivores.

By the Neolithic period, or New Stone Age, humans began to confront the limits of nature in a new way. As societies became settled and built cities and nation states, their demands and impacts on the environment increased. And, quite often, their declines were caused by environmental destruction.

Cultures typically arose and flourished due to the availability of important resources. As food supplies and economic growth increased, their populations grew in response. Those larger populations required that the resources be utilized more intensively, and eventually over-exploited those resources. Civilizations ultimately collapsed when the resource base could not support their population.

A "Modern Mesopotamia"

The collapse of Mesopotamian civilization due to population increase and environmental degradation almost 4,000 years ago is today mirrored on a smaller scale around the five major oases of Egypt. Egypt is the most populous country in North Africa (over 66 million people) and is growing at a rate that, if maintained, will cause population to double in under 30 years.

In response to that growth, the government initiated projects to move people from the crowded Nile Valley to the desert oases. Unfortunately, the Nile farmers brought their traditional techniques with them, including flood irrigation and water-intensive crops like rice. Without a renewable water source like the Nile, these farming methods severely depleted the aquifer of Kharga Oasis, and now threaten that of Siwa. Around Farafra, the population has nearly tripled in just three years due to inmigration, and farmed area around the oasis has increased more than seven times. That combination has dramatically multiplied water demand.

Flood irrigation causes salinization of the soil, because the high temperatures of the desert evaporate the water and leave the minerals behind. The normal response to salinization is fallowing - taking the land out of production so nature can restore it. But as in ancient Mesopotamia, the needs of a growing population prevent that in modern Egypt.

Because salinization gradually robs the land of its productivity, vast areas of formerly rich farmland around Kharga have turned to desert. Modern observers now see the same thing Mesopotamian scribes recorded around 2000 B.C.E. from salt build-up- barren fields and "the earth turned white."

One example of this is the ancient culture of Mesopotamia (located between the Tigris and Euphrates Rivers in what is now Iraq), where writing was first developed. City-states there prospered from fertile soils and plentiful water for irrigation. As agricultural production increased, however, so did population. To feed that larger population - and support the apparatus of a state, including an army and administrators - fields were expanded and farmed more intensively.

Eventually, as the limits of arable land were reached, increased food production became dependent on increasing yields. In trying to feed that larger population, farmers over-irrigated their fields, and eventually the soils became too salty to sustain crops. In the resulting collapse, the once-mighty civilization vanished, and its people scattered.

Population pressure played a significant part in the decline.

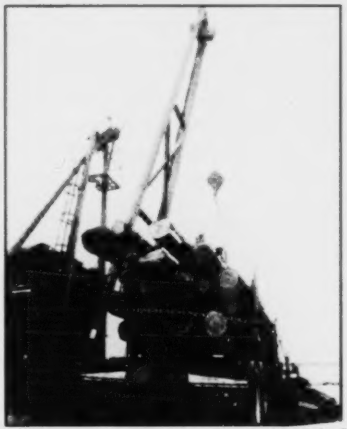
The extensive and elaborate Mayan culture of Central America may also have collapsed due to population pressures. Primarily known today for their magnificent pyramids and temples, the Maya were dependent on the corn crop. As long as population remained within the carrying capacity of the region, corn could be raised by clearing small plots of jungle, planting them for a season or two, and moving on before the soil was exhausted. The jungle then reclaimed the field, and in a matter of a few decades, allowed the cycle to be repeated.

As the culture prospered and population increased, however, the Maya were forced to farm more intensively, clearing larger patches, and planting them more frequently. The result was exhaustion of the thin soils through mineral depletion and erosion. Decreased crop yields, combined with chronic water scarcity exacerbated by a larger population, likely led to the collapse of the southern lowland Maya cultures in the late Classic Period.

Scarcity caused by overpopulation and environmental degradation may also have been the driving force behind the inter-city warfare that characterized the Postclassic period in the northern lowlands. By the time of the Spanish invasion, the Maya had abandoned most of their great cities, and dispersed.

Perhaps the most dramatic and best-documented example of overpopulation destroying a local environment - and ultimately the culture dependent upon it - is Easter Island. This small island in the South Pacific - now known primarily for its enormous carved stone figures, or *moai* - was settled around 500 C.E. by Polynesian seafarers. Their culture flourished for several hundred years due to plentiful resources, including dense forests and abundant wildlife.

But population growth caused the culture to exceed the island's carrying capacity by about 1500 C.E., resulting in deforestation, exhaustion of the soil, and extinction of most species. By the time European explorers arrived in the early eighteenth century, the island was completely barren, and the culture had collapsed. The remaining people - reduced by some two-thirds from peak levels - were engaged in constant warfare over the few remaining resources, and practiced cannibalism.


Industrialized nations - especially the United States and Canada - consume and waste huge amounts of wood.

Modern Impacts - The Loss of Forests

As the history of Easter Island demonstrates, the decline of forests is not a modern phenomenon. What is unique today is the rate and extent of deforestation globally. Earlier in this century, forests covered around 40 percent of the earth's total land area. Today, that forest cover is down to 27 percent - a loss of roughly one third. In developing regions, where population pressures have forced accelerated clearing of forests for agriculture and fuelwood, that loss is estimated to be nearer one-half.

The destruction of forests - temperate and boreal, as well as tropical - poses a number of environmental problems. Forests help regulate the amount of carbon dioxide (the primary greenhouse gas) in the atmosphere. As forests are cleared, not only is the earth's ability to absorb carbon reduced, but the carbon retained in the trees is also released into the atmosphere.

Forests also help stabilize local and global weather. Large-scale deforestation is linked to changes in weather patterns, as well as to soil erosion and siltation of rivers. Increased flooding in India and Bangladesh is now believed to be caused by deforestation in the Himalayan Mountains, where many of the sub-continent's rivers begin. Recent disastrous floods in China and Honduras are also linked to deforestation.

The specific reasons for deforestation vary by region, but the underlying cause is simple - increasing numbers of people, and increasing demand for wood products. According to an extensive study by the United Nations, 79 percent of total deforestation between 1973 and 1988 was a direct result of population growth. By far the greatest cause of forest loss was clearing for agricultural purposes in developing regions. The second greatest cause was fuelwood harvesting in those regions - especially in Africa, where 90 percent of the population rely on wood products for cooking and heating.

Not all the blame for this problem can be laid on less-developed regions, however. Even though deforestation rates are greatest in the developing world, over half the wood harvested is consumed by industrialized countries. In the developed world - where Temperate and Boreal forests are falling to logger's saws at rapid rates - timber harvesting is the primary cause of deforestation. In Canada, more than 1 million hectares are cut annually, while in Siberia, the rate may be as high as 4 million hectares annually - twice the deforestation rate of Brazil. (One hectare equals 2.47 acres.)

The consumption patterns of industrialized nations - especially the United States and Canada - drive this harvest. The US alone consumes over one-third of the world's total paper supply, the majority of which goes for packaging and advertising. Huge amounts of wood are also consumed by the construction industry. Some of this is to build more infrastructure to support growing populations, and some is in response to growing per capita consumption. Americans now live in homes almost twice the size of those they lived in 50 years ago, and occupy two-and-one-half times the residential space per person. More than 10 million Americans own two or more homes, and there are more shopping malls than high schools in the US.

If current population growth and development patterns continue, deforestation will expand. Over 95 percent of future population growth is expected to occur in developing regions, where most tropical and temperate forests are located. Poverty and lack of access to land - combined with scarcity of health care, education, and infrastructure, which will limit economic options - will force people to clear the forests. Destruction of temperate and boreal forests in industrialized regions will also continue if more people live higher consumption lifestyles.

These trends can be reversed, however. Investments in social health, education, and sustainable development - along with respect for human rights - can stabilize population. Efficiencies in production and processing can reduce timber harvest, and economic policies that account for (and tax) the damage due to deforestation can reduce demand for wood products.

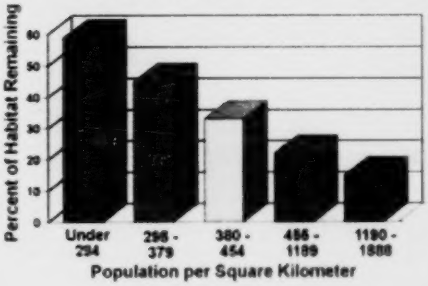
Nature Doesn't Give Second Chances

In 1996, the World Conservation Union (IUCN), completed the first-ever extensive survey of the status of animal life on Earth. The 600 plus participating scientists concluded that of the species surveyed, 34 per-cent of fish, 25 percent of mammals and amphibians, 20 percent of reptiles, and 11 per-cent of birds are threatened with extinction. Another 5 to 14 percent of species in these groups are "nearing threatened status." Species extinction rates worldwide are now estimated to be 100 to 1,000 times greater than normal, and are rising dramatically.

"The declining health of vertebrates is but one indicator of a decline in many facets of the natural world," says author and researcher John Tuxill of Worldwatch Institute. "Plants, insects, snails, and many other organisms are also threatened. Together, all of these life forms make up what scientists call biodiversity - the rich diversity of life that underpins everything from food production to a host of essential medicines."

"The leading cause of vertebrate declines is human destruction of old growth forests, wetlands, chaparral, and other rich habitats," Worldwatch reports. "Worldwide, over two-thirds of the earth's habitable land surface has been significantly disturbed by human activities. Nearly half of the world's 233 primate species are threatened, largely because of their dependence on large expanses of tropical forest, a habitat under siege around the globe. In hotspots of forest loss, such as Madagascar, the Atlantic rainforest of eastern Brazil, and Southeast Asia, roughly 70 per-cent of primate species face extinction."

Population Density and Habitat



Extinction of Species

As clearly linked to population increases as deforestation, biodiversity loss is accelerating worldwide. Each year, perhaps 27,000 species vanish forever - a rate of extinction equal to almost three plants, animals, insects, or microorganisms disappearing every hour. In fact, species are disappearing so fast, many of them are not even named, much less studied and understood, before they are lost forever.

At this rate, scientists estimate that as many as one fifth of all life forms on earth will disappear in the next 30 years. (No one knows how many unique species inhabit the Earth. Estimates run from a low of around four million to a high of 100 million. Extinction rates have been variously estimated at anywhere from a low of 6,000 species to as high as 60,000, or even 90,000 species annually.)

The main threats to biodiversity are rooted in human numbers and behavior. As tropical forests are destroyed, the unique biota inhabiting their watersheds - which comprise roughly half of all species on the planet - are destroyed. As wetlands are drained or filled to provide farmland, as well as commercial and residential real estate, more species are lost. Many helpful insect species are killed by application of pesticides, while intensive mechanized and chemical-dependent farming practices destroy fungi and microorganisms in the soil. And, as humans introduce species from other areas, native species often are either unable to successfully compete for resources, or become prey to the introduced species.

Perhaps the clearest correlation of population size to species loss is that of human density to wildlife habitat. According to a study of 50 countries by Paul Harrison ("The Third Revolution," Taurus, 1992) those areas with the greatest population density retain the least wildlife habitat. For example, countries with population densities under 294 people per square kilometer (such as the US) retained an average of 59 percent of wildlife habitat. Nations with densities under 379 per square kilometer retained 45 percent on average, while nations with densities of up to 454 per square kilometer retained only one third of their original habitat. In the most crowded countries - averaging from 1190 to 1888 people per square kilometer - barely 15 percent of original habitat remained.

Marine ecosystems are also in decline due to factors such as water diversion and pollution, sedimentation from upstream soil erosion, over-harvesting, and introduced species. While land species receive the most attention, marine species are in many ways more diverse, and more threatened. Almost half of the Earth's animal phyla are exclusively marine, and 31 of 32 known animal phyla are represented in marine environments.

Marine species provide a large percentage of humans' protein supply. They also absorb tremendous amounts of CO$_2$, and hold the potential for important pharmaceutical advances. Indicators such as shrinking fish stocks and shellfish harvests, extinction of numerous freshwater species, and the decline of coral reefs all demonstrate the increasing threat to marine biodiversity due to human activities.

The Atmosphere

Human numbers and activities also negatively affect the Earth's atmosphere through releases of pollution that causes smog, acid rain, and depletion of the ozone layer. This is directly related to human activities and numbers, because it is largely a result of emissions from automobiles and industrial plants.

World vehicle production is now approaching 50 million units annually, and the total world fleet exceeds 500 million vehicles. As more people operate more automobiles and demand more energy produced by burning oil, coal and natural gas, emissions - and therefore air pollution - will increase further. Increasing levels of carbon emissions are also linked to what may be the most serious long-term threat to humanity - global climate change.

On a local level, pollution translates into degraded air quality, or smog. In Mexico City - which has a population density double that of New York and is the largest of the developing world's "megacities" - the air quality is considered the worst in the world. On some days, the smog is so thick that factories and schools are ordered to close, and cars drive with their lights on. Just breathing the air in Mexico City - which is home to around 20 percent of Mexico's rapidly growing population - is said to be the equivalent of smoking two packs of cigarettes a day.

In China - where rapid industrialization has been driven largely by coal-fired power plants - the major cities of Shenyang, Xian, Beijing, Shanghai, and Guangzhou rank among the 10 most polluted cities in the world. The most populous nation on Earth, China, has seen death rates due to respiratory diseases increase nearly 25 percent just in the last 10 years.

In Xian, the capital of Shaanxi province, respiratory diseases have reportedly risen 10 per cent annually over the past several years. In Shanghai, the air reportedly contains 302 different types of chemicals (one-third of which are carcinogenic) and an estimated 300 to 500 people die every year due to poor air quality.

In the United States, the Environmental Protection Agency estimates that some 60,000 people die each year from respiratory problems linked to particulate emissions. An average of 14 people die each day from asthma aggravated by air pollution - an increase of 300 percent in the last 20 years. Airborne "haze" has decreased visibility by as much as 70 percent in some parts of the country, and has degraded visibility even in formerly pristine areas. One-third of haze in the Grand Canyon is a result of pollution generated in Los Angeles, as is one-fifth of haze in the Rocky Mountain National Park on dirty air days.

As a regional issue, air pollution is evident as acid rain. As pollution particles from the burning of fossil fuels react with sunlight, oxygen, and moisture

The Environment and Human Health

"Cities harbour threats to health unknown in rural settings. Most important is the pollution of air and water as a result of industrial activity, transportation and cooking exhausts. In the larger megacities, particulate concentrations are direct hazards to health. Mexico City and São Paulo, for example, are afflicted with excessive levels of carbon monoxide, ozone and particulates that lead to increases in respiratory and cardiovascular diseases. In MexicoCity, lead poisoning caused by emissions from cars and trucks is thought to be the cause of 140,000 children requiring remedial education, and of hypertension in 46,000 adults of whom 330 die yearly from heart attacks. In Cairo, lead concentration in the air is five to six times greater than global norms and the blood of children has lead content levels three to five times higher than children in rural Egypt."

From "Conditions of Life in Urban Areas," The State of World Population 1996," by the United Nations Popu-lation Fund.

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in the atmosphere, they are transformed into new compounds. Sulfur dioxide becomes sulfuric acid, and oxides of nitrogen become nitric acid. When these airborne acids fall on earth in the form of precipitation, they can kill fish in lakes and streams, damage forests and crops, and corrode metals.

In Europe, the United Nations estimates that nearly one-quarter of total forests have been damaged by acid rain. In Great Britain, the total forest area damaged is well over half. According to China's National Environmental Protection Agency, acid rain generated by emissions from burning coal is said to fall over more than 40 percent of the country. Because of the damage sulfur dioxide inflicts on agricultural lands, it has come to be known as "an airborne god of death."

Global air pollution appears in two different forms - ozone depletion and global warming - each with unique hazards and challenges to humans and the environment. Depletion of the ozone layer is due primarily to emissions of chloroflourocarbons, or CFC's. These chemicals are commonly used as fluids in air conditioning systems, as aerosol propellants, and as industrial solvents. Scientists believe that a single chlorine atom released into the atmosphere as part of a CFC compound can destroy up to 100,000 ozone atoms.

Despite an international agreement limiting CFC use after 1996, release of these compounds into the atmosphere will continue for at least another decade. Developing nations were granted an exemption until 2005, and developed nations are allowed to manufacture CFC's for export to those countries. Some chemicals used as substitutes for CFC's are also known ozone-depleters, and their production is only beginning to be phased out. Because CFC's may remain in the atmosphere for 50 to 100 years, destruction of the ozone layer will continue long after CFC production ceases.

Depletion of the ozone layer allows more ultraviolet radiation to hit the Earth's surface, which scientists believe will cause serious damage to plants, mammals, insects, and birds. Increased ultraviolet exposure may also damage the human immune system, and is a known carcinogen. According to the US Environmental Protection Agency, degradation of the ozone layer and subsequent exposure to increased amounts of ultraviolet light will cause 12 million people to develop skin cancer over the next 50 years in the US alone. More than 200,000 of those cases will prove fatal.

Global warming and climate change are the most critical environmental impacts imposed on the atmosphere by human pollution. Although world weather patterns are little understood, it is clear that global temperatures are rising. All 10 of the warmest years on record have occurred since 1980, including a record-high temperature in 1998. Worldwide carbon emissions and atmospheric concentrations of greenhouse gasses reached record levels in this period, as more people burned more wood, coal, and petroleum products.

While the overall effects of human actions on the earth's weather patterns are uncertain, the negative impacts of global warming are clear. Rising sea levels and natural disasters such as hurricanes threaten citizens physically and economically. Crop-scorching heat waves, unseasonable storms and flooding, and drought threaten individuals, communities, and global food security. If the earth continues to warm and ice packs melt, rising sea levels will threaten coastal communities (where a large percentage of population is concentrated) around the globe.

Currently, the 1.2 billion people in industrialized countries generate the majority of carbon emissions, due to lifestyle choices and consumption patterns. But developing countries already contribute over one third of the total. As those countries - where the majority of population growth will occur in the next several decades - develop further, their emissions will increase significantly. Based on anticipated growth rates, the United Nations Population Fund projects that developing countries will double their carbon dioxide emissions by 2025.

Conclusion

Global population is expected to increase by some 80 million people each year for perhaps the next 30 years. At the same time, more nations - and billions more people - will achieve higher levels of economic development, production, and consumption. This in turn will significantly increase usage of natural resources and energy.

Clearly, all nations and people are entitled to improve their living situations. However, if present trends continue, damage to the environment is certain to increase and accelerate.

The good news is we can preserve the natural world, and our own security. But in order to do so, we will have to stabilize population, develop renewable, non-polluting energy systems, and implement sustainable technologies and production practices.

These goals are neither particularly difficult from a technological standpoint, nor terribly expensive. We could do all the above with far less effort and money than the world currently spends on weapons and wars. And we could create a strong, sustainable economy in the process. But in order to do so, we must define and share a vision of a positive, secure, and healthy future, and work together to create it.

OT

Economic and Social Impacts of Population Growth

The Numbers Game
Just do the math

The Rise of the Mega-City
Bigger is not necessarily better

Correlatives
Population and crime, health, and jobs

Population and Poverty
Does population growth cause poverty, or does poverty cause population growth?

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In poor societies, large families may be an economic necessity

Population, Poverty, and Conflict
When too many people have too few resources . . .

Facing The Future
People and the Planet

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While connections between population growth and environmental damage may be fairly easy to understand, the economic and social impacts of that growth are often more difficult to see. At first glance, hunger, poverty, disease, and unemployment may appear unrelated to population growth. So may homelessness, crime, migration, and war. But if we recall the example of the mobile, we can see how these issues are interconnected.

When we have more people, we have more needs. We need more food, more water, more housing, and more jobs. Growing populations also impose greater needs for infrastructure. They strain transportation, education, energy, and waste disposal systems. More people also require more services, from police protection to health care.

When insufficient resources exist to support any population (or when population is growing faster than resources or services can be provided) scarcities occur. If food is scarce, people go hungry. If housing is scarce, people are homeless. And if jobs are scarce, people are unemployed.

Resource scarcities due to population pressures (and to inequitable distribution of resources) cause a number of problems. They force domestic and international migration, exacerbate social, religious, and ethnic tensions, and drive wars and civil unrest.

Virtually every important issue we confront today is caused or multiplied by population growth. Unless this growth is checked, it will be difficult - and perhaps even impossible - to solve these pressing problems.

The Numbers Game

One way to understand the stress increasing human numbers place on social and economic institutions is through the formula, **H = R÷P**. This means that the human condition **(H)** is determined by available resources **(R)**, divided by population **(P)**. Simply put, the more people who require a slice of any particular pie, the smaller the piece each one receives. Only if the rate of resource consumption is sustainable, and production meets or exceeds the rate of population growth, does the human condition improve.

The H = R÷P formula can be demonstrated in a number of situations around the world. As noted in *Tracking the Trends*, essential resources such as arable land, forested area, fish catch, and fresh water availability are all declining on a per person basis.

H = R ÷ P
Human condition equals Resources divided by Population

H = R÷P can also be demonstrated economically. Since 1950, Gross World Product (GWP) has increased by almost six times. During that same period, however, because of population growth, per capita GWP has increased only about two-and-one-half times. Because per capita GWP is determined simply by dividing GWP by population, it does not reflect the growing gap - both within and among nations - between rich and poor.

Because of population growth, that economic disparity, and underlying structural issues (including corruption), the United Nations Development Program (UNDP) estimated in 1999 that the richest 20% of the world's people consumed 86% of all goods and service, while the poorest 20% consumed only a bit over one percent. In 1998, a UN committee concluded more than one billion people lived on less than one dollar per day, and almost three billion on less than two dollars per day.

Rates Versus Numbers

Scarcity caused by larger populations competing for limited resources appears in many other areas. Because there are so many more people, even if a smaller *percentage* of them are in need, the overall *number* of people in need can be larger than ever. UNDP, for example, says that, "While the relative incidence of poverty, illiteracy, and hunger has declined or remained constant, with increasing population absolute numbers of deprived people have increased. In Sub-Saharan Africa numerous indices of welfare have declined."

This means, for example, that even though a higher percentage of children are in school, because of rapid population growth, the overall number of children not in school in many regions is higher than ever. UNDP research indicates that in the developing world, 130 million children are out of school at the primary level, and more than 275 million at the secondary level. In Latin America and the Caribbean, South Asia and Africa, only half of the children who enter the first grade reach grade five.

This helps us understand why, despite declines in India's poverty rate, the number of people there who live in poverty is steadily increasing because of population growth. It also explains how unemployment rates can be lower in some countries, while greater numbers of people are unemployed.

The Challenge Of The Urban Future

"...will be to sustain progress in social development in the face of unprecedented pressure. The assumption that urban growth will power development has held in many countries in Asia and some in Latin America. But even as urban-based economies grow, they are in danger of being overwhelmed by the sheer numbers of the poor and the dispossessed.

"Poverty has not risen in step with population growth: in a number of countries in Asia the numbers of the poor have actually declined since the mid-1980s. But overall, the absolute number of the urban poor is still increasing. There are now an estimated 600 million people in urban areas in developing regions who cannot meet their basic needs for shelter, water and health from their own resources. Half the populations of cities in some of the world's poorest countries are living below official poverty levels. Poverty will present itself increasingly as an urban problem.

"The new urban masses' success in finding livelihoods will determine the viability of cities and nations. It is not only a matter of creating employment opportunities: in the long term it will require larger and more effective social investments: in health, especially for reducing infant and maternal mortality; improving reproductive health, promoting family planning and sexual health, and controlling the spread of infectious diseases; in education, especially for girls and women; and in promoting autonomy and equality for women by these and other means."

From "The State of World Population 1996," by the United Nations Population Fund.

The Rise of the Mega-City

One of the most visible examples of growing world population is the increase in urbanization. Since 1950, the number of people living in cities has more than quadrupled - from around 700 million to roughly three billion - mostly in the developing world. This trend is expected to continue as population growth, environmental degradation, and loss of agricultural jobs drive people from rural areas to cities. Projections by the United Nations indicate that roughly four billion people will live in cities by 2025.

Rapid urbanization is associated with a number of social and economic problems, including pollution, crime, unemployment, disease transmission, poverty, and homelessness. Population growth strains political institutions, and influxes of people from the countryside place tremendous demands on city services.

Living in the City of the Dead: Housing is so scarce in Cairo, Egypt, that hundreds of thousands of people (like the children above) are forced to live in the cemetary. John Goekler photo.

Cities may be unable to provide housing, clean water, or sanitation to rapidly-growing populations. In 1990, the United Nations estimated that 600 million residents of the developing world lived in "life and health-threatening homes and neighborhoods." The number of homeless in those regions may be as high as 200 million, and in Latin America alone there are an estimated 20 million "street children."

Population and Crime

Because of high urban birth rates, and the fact that most economic migrants are in the 15 to 25 age group, many cities have quite young populations. This not only places more stress on education systems and job markets, it also results in social tension and political unrest. Young people are more likely to be involved in criminal activities, and in many cities of the

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developing world, street crime and violence are increasing dramatically.

In India - the world's fastest growing nation and the second most populous - there is a strong correlation between population growth, environmental degradation, and communal violence. Between 1955 and 1985, total population nearly doubled, while the incidence of communal violence increased sevenfold. The number of deaths resulting from these incidents increased more than tenfold. Similar increases in violence relative to population growth can be seen in such diverse locations as Rio de Janeiro, Brazil, Lagos, Nigeria, and Dacca, Bangladesh.

Studies in the United States have also shown a correlation between city size and crime rates, with larger cities generally suffering more crimes per capita than smaller cities. Even more significant are recent studies in some major US cities that indicate a strong correlation between violent crime, poverty, and overcrowding. Despite common perceptions that violent crimes are primarily committed by young African American males, these studies indicated that race was not a factor in the incidence of criminal behavior.

Instead, they found that crimes were most likely to be committed by poor people - regardless of race - living in overcrowded conditions. Middle class African Americans were no more likely to commit crimes than middle class whites, Asians or Hispanics. The higher per capita incidence of crime among African Americans overall was attributed to a correspondingly higher per capita incidence of poverty among African Americans, and a greater concentration of African Americans in densely-crowded urban environments.

Population and Health

In health care, the H = R + P formula means that in order to maintain levels of care, more doctors, clinics, and medical supplies are required to treat larger populations. But providing such resources fast enough to keep up with rapid population growth may be impossible for cash-strapped governments. Studies also indicate that the faster the rate of population growth, the less likely it is that immunization programs can stamp out childhood diseases such as measles, rubella, and mumps, because there are simply too many children to reach.

Health concerns in the world's rapidly growing cities are also linked to population density and environmental degradation. Disease is more easily transmitted in crowded conditions, and shortages of clean water and sanitation services increase the incidence of many diseases such as cholera. Incidences of tuberculosis and HIV/AIDS infection are also higher in urban conditions.

The linkage between increasing population and health and social concerns is not limited to the developing world. In fact, there is a strong correlation between population growth and declines in social well-being in the United States. According to the 1998 Index of Social Health published by Fordham University, the social health of America has declined by over 40 percent in the 27 years since the study began, while population rose by over 30 percent. (See, *"Does the US Have a Population Problem?"*)

Population and Jobs

The H = R+P formula also applies to employment. Productivity and economic growth have increased tremendously during the latter half of this century, largely due to increased mechanization and improved technology. The result of this development, however, has been a decrease in agriculture and manufacturing jobs, even as more and more workers enter the job market due to population growth.

Population and the Spread of Disease

On the eve of the 21st century, infectious diseases that threaten human health are emerging (and reemerging) at rapid rates. In the past 25 years, the Ebola virus, Human Immunodeficiency Virus (HIV, which causes AIDS), and Hepatitus C have emerged. Tuberculosis and malaria, once thought to be in decline, have become the leading killers among communicable diseases. Epidemics of cholera, dengue fever, diphtheria, and meningococcal meningitis have occurred in many parts of the globe.

Several factors contribute to this trend, the World Health Organization (WHO) reports but most can be linked to "increasing numbers of people living and moving in the world." Causes of disease transmission include overcrowding in cities with poor sanitation, increased international trade in food and unhealthy food preparation practices, and a deteriorating public health infrastructure that cannot keep up with the needs of ever-larger populations.

Increasing population density also forces people out into areas previously unoccupied, and expose[illegible]hem to natural disease vectors and reservoirs. WHO identifies alteration of the environment through such practices as road-building, mining, logging, agriculture, and irrigation as a factor in disease outbreaks, because it brings humans into contact with natural disease vectors such as infected animals and insects. Global warming and other climate changes such as El Niño also allow disease-transmitting insects (such as the Anopheline mosquitoes that transmit malaria) to move into new areas and spread disease.

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Some of these job losses have been offset by increased service jobs, but often at lower wages. In this case, the jobs (R) have not increased in ratio to population (P). The result is lower wages and greater unemployment, or declining economic security (H).

The decline in living standards due to unemployment and lower wages is a global problem. The International Labor Organization (ILO) estimates that, out of a world labor force of 3 billion people, 25 to 30 per cent are underemployed and about 150 million workers are fully unemployed.

The ILO stated in its 1998-1999 World Employment Report, ". . . overall, with few exceptions, the employment situation has remained unfavourable and high levels of unemployment are a source of considerable concern in most parts of the world. Although the employment outlook has picked up somewhat in a number of industrialized countries, this has to be weighed against the persistent difficulties faced by Central and Eastern Europe, and against the worsening situation in East Asia. Elsewhere, in South Asia and in Africa, there has been no significant improvement. In Latin America economic growth has resumed but unemployment has shown little sign of abating."

According to the ILO, 47 million new workers enter the global job market every year. Over the next 20 years, the United Nations expects 750 million new workers to enter the labor market simply from population growth.

In China, as many as 120 million people are unemployed in rural areas, and 70 to 150 million *liudong renkou*, or "floating people" migrate from city to city in search of work. Much of this employment scarcity is in the western and southern part of China, which helps explain the influx of Sichuanese workers to Tibet, further exacerbating tensions there.

Again, the United States is not immune to this issue. Due to both automation and a larger labor pool from population increase, real wages - after adjusting for inflation - remained relatively flat in the US from 1973 through 1997. During much of that period, real wages actually declined. Only in 1998 and 1999 - during an extended economic expansion - did they actually increase.

Homeless child in Calcutta, India. FAO Photo

Mexico, with a population growing at 2.2 percent annually, needs to create one million new jobs each year - a goal to which it has been unable to even come close. This lack of economic opportunity is a major cause of high levels of legal and illegal immigration to the US. Along with lack of access to land, environmental scarcity, and social inequity, it is a key component of civil unrest in states such as Chiapas.

Population and Poverty

Poverty is an integral piece of the population puzzle. Poverty is linked to social breakdown, domestic violence, unintended pregnancy, illegal drug use, environmental destruction, and, as noted above, to violent crime. Whether population growth causes poverty or whether poverty causes population growth is a matter of great debate. (At Facing the Future, we would argue that both are true!) What is clear is that, despite remedial efforts, poverty is increasing.

The percentage of people in poverty is declining, but the absolute numbers are rising. In the developing world, more than 1.3 billion people are affected by "income poverty," (meaning they exist on less than one dollar a day) and roughly one billion are affected by "human poverty," (meaning they lack essential services such as clean water, sanitation, education, and health care.)

More than 800 million people around the world do not get enough food. According to the United Nations Development Program, more than one-third of all children in the developing world are malnourished. The UNDP also estimates that nearly 2 million people, many of them children, fall below the poverty line each month. By the year 2000, according to United Nations projections, more than three out of four urban families in developing countries will be living in poverty.

The causes and consequences of this are many and varied. As the United Nations International Conference on Population and Development reported, "Poverty is often accompanied by unemployment, malnutrition, illiteracy, low status of women, exposure to environmental risks and limited access to social and health services, including reproductive health services which include family planning. All these factors contribute to high levels of fertility, morbidity, and mortality, as well as to low economic productivity."

The environmental consequences of poverty include overgrazing, deforestation, agricultural mismanagement, and over-cutting of fuelwood, since poor people carry out a disproportionate share of these activities in an effort to provide for their families. Ac-

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cording to a recent UN study, some 70 percent of the damage to the world's soil is a result of these practices.

Poverty has also risen significantly in the United States in the past 20 years. Over 35 million Americans now live in poverty, including over one-fifth of all US children. Because of structural differences between this society and the developing world, children tend to be more of an economic liability than an asset. But according to the Population Reference Bureau, there is still a strong correlation between family size and poverty. While barely five percent of families with no children live in poverty, over 25 percent of families with three children live in poverty. Over 35 percent of all US families with four children live in poverty, while well over half of all families in the US with five or more children live in poverty.

When Children Are an Asset

One of the key links between poverty and population is the fact that in poor societies, children are an economic asset, and even a necessity. In Eastern Africa, for example, where the Total Fertility Rate is 6.0, women may have many more children than seems reasonable to some outside observers. If food is scarce, they ask, why not simply have fewer mouths to feed?

The first response is that poor women may not have the education, the social status, or the access to reliable materials to control their own fertility. But the larger issue may be that numerous children are a necessity due to the harsh realities of some regions. Families may expect one or two of their children to die of disease before age five, and may need several children to help raise or gather food, haul water, and collect fuelwood.

As environmental degradation from population pressure accelerates, families may have to walk further to gather these resources, and therefore need even more children. In other situations, children may beg on the street to help support the family, be hired out to "sweatshops," or sold into slavery or prostitution. (The UNDP estimates that every year, one million children are forced into prostitution - mostly girls in Asia.) In parts of Africa, many daughters are desired, because when they marry, the family receives a traditional "bride price." In all these scenarios, additional children help families meet their economic needs.

These contextual issues clearly complicate efforts to achieve a sustainable population. If family size is determined by a household's economic needs, then simply providing access to family planning materials will have little or no effect on fertility. However, creating economic opportunity along with providing family planning materials, education - especially for girls - and health care may have a profound impact. Addressing unique local needs such as providing kerosene stoves and fuel, or a convenient, safe water supply may also dramatically reduce family size in a single generation.

Children as Resources

According to the International Labor Organization, some 250 million children under age 15 are working in developing countries, with roughly one-third of them performing dangerous tasks. Child labor also exists in many industrialized countries including the United States, and is on the increase in many economies in transition in Asia and Eastern Europe. Child workers are most often employed in agriculture, manufacturing and mining. (Child labor does not include light work, after school jobs, or helping out in the family business.)

Children - some as young as eight years old - are also used as soldiers in almost every region of the world. An estimated 250,000 children currently serve in government or opposition forces today. According to Human Rights Watch, "Children are most likely to become child soldiers if they are poor, separated from their families, displaced from their homes, living in a combat zone or have limited access to education."

An estimated one million children - mostly girls in Asia - are sold into prostitution each year. According to The Centre for Development and Population Activities, "most victims are impoverished girls aged 13-18, who are kidnapped, lured by promises of jobs or marriage, or sold to traffickers who ship them to urban centers and neighboring countries.

"Pervasive poverty, low education levels among girls, and the lower social status of girls and women contribute to a potential supply of girls vulnerable to trafficking and exploitation."

Many children are an asset to poor families: A young boy helps his father mine for gold in Venezuela. Photo by J. Mailard, courtesy of ILO

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Population, Poverty, and Conflict

Once the connection between population, resource availability, and human condition is recognized, other impacts of population growth become apparent. These include internal and international migration as responses to resource scarcity, as well as civil and trans-boundary conflict and war. Whenever a local population is unable to adequately support itself on available resources, it has few choices. It can continue to suffer a decline in living standards, or it can attempt to obtain additional resources - either through redistribution within society, or through migration to another location.

Children scavenging for food at the dump in Recifa, Brazil.
FAO Photo

Either of the above scenarios presents major social and security problems. Few societies are likely to accept a continually declining standard of living - particularly those already living a marginal existence. Declining living standards foment civil unrest, internal conflict between social classes, ethnic groups, or religious adherents, and political instability.

Redistributing resources within a society, especially during a time of scarcity, presents similar dangers. Those controlling resources are reluctant to give them up, and those needing resources may resort to desperate measures to obtain them.

With more than six billion people living on the planet, mass migration also presents serious problems. Quite simply, there are few habitable places left to move to. Virtually all the productive cropland, forestland, water sources, and fisheries in the world are being exploited at or over capacity. When any group is forced to migrate due to population-induced scarcity, conflict with existing residents is likely to occur. Particularly as host countries or regions struggle with their own social and economic concerns, newcomers may be perceived as taking jobs, imposing an economic burden, or "corrupting" local culture.

One relatively mild example of this conflict is the growing hostility in the United States toward legal immigration. As rapid population growth and economic scarcity drive people to migrate from regions such as Latin America and Asia, many in the US are calling for stringent limits on immigration. Citing concerns about job losses, higher taxes, and demands on services, both state and federal lawmakers have passed punitive legislation targeting immigrants.

In Germany - which continues to grapple with the economic and structural issues of reunification - resentment against the large Turkish immigrant community has led to a series of assaults on Turks and arson attacks against their homes and businesses. In Assam, India, resentment is focused on immigrants from Bangladesh (estimated unofficially at 12 to 17 million people) who fled the crowding and poverty of their homeland. This tension has led to numerous clashes, including anti-immigrant massacres in which thousands of Bangladeshis died.

In other areas, conflict resulting from environmental scarcity has been even more violent and extreme. Examples of this include Rwanda, a rapidly growing nation with a population density among the highest in Africa. There, rapid population growth, environmental degradation, and resource scarcity exacerbated existing ethnic tensions. In the resulting conflict, some one million people perished, and as many as two million were displaced. That conflict has also spilled over national borders to involve other countries, and has inflicted tremendous environmental damage, as refugees cut down forests for fuel and damaged soils from intensive farming and overgrazing.

Some 30 "high-intensity" wars are currently raging around the planet, as well as dozens of "low-intensity" or localized conflicts. While it is overly simplistic to say that population growth causes war, there is a substantial correlation between increasing human numbers, resource scarcity, and the number of conflicts.

Resource scarcity is a key factor in conflicts on the border of India and Bangladesh, in South Africa, and in southern Mexico. It is at the heart of tensions in the Middle East, where shortages of water and farmland are central to the Israeli - Palestinian conflict. Water resources are the source of persistent tensions between states such as Turkey, Syria, and Iraq, as well as between Egypt, Sudan, and Ethiopia. As growing populations demand more water for both urban and agricultural uses, this conflict is likely to intensify.

Population, Scarcity, and Security

"This sub-national violence will not be as conspicuous or dramatic as interstate resource wars, but it will have serious repercussions for the security interests of both the developed and the developing worlds. Countries under such stress may fragment as their states become enfeebled and peripheral regions are seized by renegade authorities and warlords. Governments of countries as different as the Philippines and Peru have lost control over outer territories; although both these cases are complicated, it is nonetheless clear that environmental stress has contributed to their fragmentation. Fragmentation of any sizable country will produce large outflows of refugees; it will also hinder the country from effectively negotiating and implementing international agreements on collective security, global environmental protection, and other matters.

Alternatively, a state might keep scarcity-induced civil strife from causing its progressive enfeeblement and fragmentation by becoming a "hard" regime that is authoritarian, intolerant of opposition, and militarized. Such regimes are more prone to launch military attacks against neighboring countries to divert attention from internal grievances. If a number of developing countries evolve in this direction, they could eventually threaten the military and economic interests of rich countries."

From "Environmental Scarcities and Violent Conflict: Evidence from Cases," by Thomas F. Homer-Dixon, Peace and Conflict Studies Pro-gram, University of Toronto.

With global population increasing by some 80 to 85 million people each year, increasing competition for scarce resources seems likely. As Dr. Thomas Homer-Dixon of the Peace and Conflict Studies Program at the University of Toronto noted, "Our research shows that environmental scarcity causes violent conflict. This conflict tends to be persistent, diffuse, and sub-national. Its frequency will probably jump sharply in the next decades as scarcities rapidly worsen in many parts of the world. Of immediate concern are scarcities of cropland, water, forests, and fish."

It is possible to head off this deepening cycle of scarcity, misery, and violence. But doing so will require that we stabilize population, affirm human rights, and restructure our economies and societies equitably.

This is without question the greatest challenge human beings have ever faced. It is not particularly difficult structurally, but will likely be very difficult culturally and psychologically. It will call for a fundamental change in the way we think about ourselves, and about our place in the human community and the natural world. We will have to choose the kind of future we want for ourselves, our children, and our planet. And we will have to call that future into being.

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Population and Religion

Population and the Pope
Political and demographic divergence among Catholics

Population and Islam
Fundamentalists preach fertility, but others support birth control

Diversity in India
Economy and education, not religion, determine family size

Other Christian Groups
Party politics and personal preference

Faith and the Future
Spirituality may be the way to sustainability

Quite often during discussion of population issues, the question of religion is raised. It is not uncommon to hear people make statements such as, "Overpopulation is a Catholic problem," or, "Muslims have big families."

While these generalizations may seem to have some basis in fact, closer examination reveals that patterns of family size vary dramatically within most religious communities. And fertility rates are more often dictated by economic and cultural realities than by religion.

It is also important to distinguish between the population-related policies of religious institutions and the personal practices of religious adherents. Religious leaders have often been effective in opposing population stabilization on a legislative or policy level, but have generally been less successful in dictating the family size of their own followers.

Population and the Vatican

The Roman Catholic Church has long been a major opponent of population stabilization and reproductive health services. Church doctrine opposes abortion, most sex education, and artificial contraception (meaning all methods other than abstinence or rhythm.) But the Church has a mixed record of success on these issues.

In the political arena, it has often been quite effective. During the Reagan and Bush administrations in the United States (1981-1992), Vatican political pressure largely neutralized American population stabilization efforts at home and abroad. Church-supported policies diverted funding from family planning programs, and caused the US to retreat from previous commitments to global population stabilization. Because the US was the world's largest donor of family planning funds, those cutbacks resulted in significant increases in unplanned pregnancies, abortions, and maternal deaths.

The Church also successfully pressured some governments of nations with large Catholic populations, such as Costa Rica and the Philippines, to eliminate or weaken family planning policies. And in 1994, the Vatican joined with fundamentalist Muslims to oppose many population stabilization and reproductive health proposals at the International Conference on Population and Development in Cairo.

Ironically, Vatican efforts to impose these views on its own parishioners have been largely unsuccessful. In the United States, the birth rate among white Catholic women is significantly lower than among white Protestant women, and the rate of overall contraceptive use varies little by religion.

The Total Fertility Rates (TFR's) in the predominantly Catholic countries of Spain and Italy are the lowest in the world. And Latin America, which is largely Catholic, has lower TFR's than Asia or Africa. These seeming contradictions explain why some analysts argue that there is no specific *demographic* problem among Catholics, but an extremely serious *political* problem with the Roman Catholic Church.

photo by John Goodwin

Population and Islam

Islam is often cited as an obstacle to population stabilization. But the Qur'an, the Muslim holy book, does not dictate large families, and many leading Islamic clerics support family planning. In fact, the Prophet Muhammad declared, "The worst problem is to possess plenty of children with inadequate means."

Many governments with large Muslim populations con-

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sider their rates of population increase to be too high, and have undertaken intensive family planning efforts. In Indonesia - the world's largest Muslim nation - fertility has been significantly reduced through extensive family planning efforts sponsored by the government and supported by religious leaders. In Turkey, that nation's Constitution guarantees "family planning education and application."

In Egypt, the government has undertaken a major campaign to reduce fertility, with the blessing of important religious leaders such as the Grand Mufti. As in many other countries in the Islamic world, however, structural issues hamper population stabilization. Egypt is a developing nation, and many of the indicators associated with large families are evident there. These include higher infant and maternal mortality rates, an illiteracy rate nearing 50% for the general population and over 60% for women, and a per capita Gross Domestic Product of under $2 per day.

These policies have been so successful that growth rates have fallen to around 1.4 percent, and Iran shared (with Viet Nam) the 1999 United Nations Population Award. Other benefits of promoting reproductive health have included reductions in infant, child and maternal mortality.

Family Planning in Iran

Many westerners view Iran as an Islamic extremist state. But the Iranian government, while largely dominated by Shiite Muslim clergy, has proven quite pragmatic on population issues.

After the 1979 revolution, Iran's rulers urged Iranian women to breed an "Islamic generation." In an effort to increase population, they lowered the legal marriage age to nine. The people responded, and birth rates soared. For a time, natural increase rates reached 3.9 percent annually - among the highest ever recorded - and Iran's population climbed from 34 million to 63 million. That degree of growth inflicted tremendous burdens on the country. The government struggled to provide schools, housing, and health care for its growing population. Economic development was unable to keep pace, and job creation lagged.

A generation later, Iran reversed course, and began to actively promote re-productive health to stabilize population. Now modern contraceptives are available without charge nationwide, and couples wishing to marry must successfully complete a family planning class. Iran has implemented a "Population Week" nation-wide, supported by religious edicts from Muslim leaders. It has also begun to stress gender equality to address the problem of male preference, which can lead to selective abortion and female infanticide.

Birth rates remain high in many other Islamic regions, despite government policy. But TFR's of 6.7 in Yemen, 6.1 in Afghanistan, or 5.6 in Pakistan do not necessarily correspond to religious values. They also indicate structural issues as noted above, and cultural traditions in which women are often isolated, uneducated, and economically disenfranchised.

(Yemen, Afghanistan, and Pakistan have high levels of Infant Mortality, reported by the Population Reference Bureau at 75, 91, and 150 per 1,000 respectively. The World Bank calculates their respective Adult Female Illiteracy rates at 79%, 82%, and 75%. World Bank also calculates Pakistan's per capita Gross Domestic Product at $502, and Yemen's at $223. Afghanistan's GDP is unknown due to the devastation of the country by years of civil war.)

As in some societies in Africa and Latin America, men's identities in those nations may also be dependent in part on their perceived virility, as demonstrated by numerous children. Within such a context, high population growth rates are much more likely to be a function of cultural values and economic necessity than of religious dictates.

Diversity in India

The largely Hindu nation of India - which is the world's fastest growing and second most populous country - is another example of context being more important than religion in determining fertility. Despite similar religious beliefs across much of that vast land (India is 80% Hindu) family size varies widely. In states such as Uttar Pradesh and Bihar, TFR's remain high, while in Kerala and Goa, fertility is below replacement levels.

There is greater correlation in India between social welfare and family size than between religion and family size. Generally the states with the highest fertility are those with the highest rates of infant mortality and undernourished children, and the lowest rates of female literacy. Those states with the lowest fertility also have relatively

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low rates of infant mortality and undernourished children, and the highest rates of female literacy.

There is also a significant correlation between family size and age at the time of marriage. States having the highest percentage of women married before age 18 generally have higher fertility rates. Those where marriage is more often delayed - because of higher education levels, greater economic opportunity or government policy - tend to have lower fertility.

Other Christian Groups

Many conservative Christians, such as members of the Christian Coalition in the United States, also oppose population stabilization and reproductive health measures. The Christian right does not appear to oppose contraception per se, but objects to information and materials being made available to young people. Any inclusion of abortion as an option is also opposed, as is open discussion of sexuality - even if such discussion is aimed at preventing unwanted pregnancies or the spread of AIDS. The Christian Coalition and its allies are well organized, and have been able to significantly shape the debate about reproductive health issues and education on both national and local levels.

The Church of Jesus Christ of Latter-day Saints (the Mormon Church) is also philosophically opposed to abortion and birth control, and Mormons have traditionally had large families. The state of Utah, which has a predominantly Mormon population, has the highest birth rate in the United States.

The birth rate among Mormons has declined somewhat in recent years, however. Church members are allowed to follow their personal preferences in the practice of birth control, and in choosing family size. The pattern of large families among Mormons, therefore, may be viewed as a cultural rather than a religious factor.

Faith and the Future

Clearly, if a sustainable global population is to be achieved, the issue of religion must be considered. But as the preceding examples indicate, it must be addressed within the larger context of culture, gender and social equality, access to health care, education, and economic opportunity.

Forcing people to have smaller families against their beliefs - as has been tried in some countries - is obviously unacceptable and violates United Nations human rights agreements. But forcing people to have larger families through religious coercion is equally unacceptable, especially when that coercion is intended to inflict the beliefs of one faith upon those of another. If world population is to be stabilized, each individual or couple must have the option, and the opportunity, to make their own reproductive choices.

Religion and religious leaders clearly have a significant role to play in creating a just, secure, and sustainable world. Traditions of faith, reflection, and service are vital components in shaping our future.

As the Parliament of the World's Religions declared in 1993, "We know that religions cannot solve the environmental, economic, political, and social problems of Earth. However, they can provide what obviously cannot be attained by economic plans, political programs, or legal regulations alone: A change in the inner orientation, the whole mentality, the 'hearts' of people, and a conversion from a false path to a new orientation for life.

"... Humankind urgently needs social and ecological reforms, but it needs spiritual renewal just as urgently. As religious or spiritual persons we commit ourselves to this task. The spiritual powers of the religions can offer a fundamental sense of trust, a ground of meaning, ultimate standards, and a spiritual home."

The Case of Kerala

Traditional models predict that fertility declines in a given population can best be achieved through economic expansion. The southern Indian state of Kerala, however, offers a very different model. Kerala has a Total Fertility Rate roughly half that of India as a whole, despite ranking last or near to last on traditional economic measures such as employment and per capita income, and despite an economic growth rate only one tenth that of India on a 10 year average.

Kerala achieved this reduction in fertility because state and local governments focused on delivering reproductive and community health care, education, and sanitation services to their citizens, rather than pursuing resource extraction and industrialization. Today, Kerala has the highest literacy rate in India, and the lowest fertility rate. It also has the lowest Infant Mortality Rate in India, and an average life expectancy some 20 percent greater than the nation as a whole.

Kerala is religiously more diverse than India as a whole. The population is 60 per-cent Hindu, 20 percent Muslim, and 20 percent Christian. All religious categories have low fertility in Kerala. The other key factor in this transition is the much higher social status of women in Kerala, and the fact that women possess significant economic rights there. Among the Nair tribal group, for example, property is traditionally inherited by daughters. And the preference for male children common in much of Asia is virtually absent in Kerala.

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Does the US Have a Population Problem?

Population and US Policy
"Pro-natal" policies and consumption subsidies

US Environmental Impacts
The largest per-person impacts in the world

Population Growth and Quality of Life
More people, more problems, even for the world's richest nation

The Future of US Population
283 or 519 million people?

Stabilizing US Population
A plan to improve quality of life at home and abroad

When population issues are mentioned, many people associate them with Africa, Latin America or Asia. But some observers contend that the United States also has a significant population problem. In terms of damage to the planet and depletion of its resources, they argue, 275 million Americans create a greater environmental impact than 1.25 billion Chinese or one billion Indians. And - despite living in the richest and most powerful nation on Earth - American citizens are suffering many of the same declines in quality of life associated with population growth in other regions.

Population and US Policy

Politically, the US is considered to be "pro-natal," meaning that it has national policies in place that encourage people to have more children. Foremost among these policies is an income tax structure that offers greater deductions for larger families. Recent political movements to grant additional tax credits for children and their college tuition reinforce this trend.

US immigration policies have also allowed an average of nearly 900,000 legal immigrants to enter the country each year during the 1990's. While actual numbers vary because of year to year adjustments, US immigration guidelines allow 480,000 "family sponsored" immigrants each year, plus 140,000 "employment preference" immigrants, and 55,000 "diversity" immigrants. Roughly 100,000 to 120,000 openings are also maintained for "refugees and asylees."

These new arrivals tend initially to have larger families than the national average, which is why some anti-immigration activists contend that the majority of US population growth is due to immigration. These new arrivals are also quick to adopt the American "super-consumer" lifestyle.

In addition to legal immigration, illegal immigration is estimated to be from 1.1 to 2.9 million each year. According to the US Immigration and Naturalization Service (INS), most of these people ultimately return to their countries of origin, but some 275,00 remain in the US. The total number of illegal immigrants living in the US is now estimated by the INS to be five million.

There is a growing debate over national immigration policies. Critics argue that it costs Americans jobs, and burdens the economy with additional social needs. Defenders of immigration argue that the United States is historically "a nation of immigrants," and that new arrivals ultimately contribute more economic value than they receive. Still others suggest that the US should work to address "push and pull factors" that drive migration, such as poverty, unemployment, economic inequity, and conflict. Regardless of the causes and context, immigration is clearly responsible for a significant portion of the total environmental impact of population growth in the US.

Economic policies in America also increase our cumulative environmental impacts. Below-cost timber sales by the US Forest Service not only contribute to habitat and biodiversity loss, and siltation of streams and flooding, they also encourage consumers to use more forest products because prices are kept artificially low. Below-cost sales of mineral rights by federal agencies and antiquated mining laws also allow corporations to make billions of dollars from exploitation of public lands and evade responsibility for resulting environmental damage. This also artificially suppresses prices, and encourages consumption.

Agricultural subsidies designed to encourage production or stabilize prices often result in significant environmental damage. Some of these impacts include soil erosion and depletion, and excessive pesticide and fertilizer applications that run off into water sources. Below cost water sales and unsustainable

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irrigation practices divert water from ecosystems, and also favor agribusiness over consumers.

Artificially depressed energy prices encourage people to drive relatively inefficient automobiles, and to waste electricity. These practices - along with billions of dollars of tax shifts and subsidies for road construction and transportation infrastructure - encourage Americans to drive more, resulting in increased carbon emissions. Those higher levels of pollution then accelerate global warming and climate change.

US Environmental Impacts

The impact of the US on the global environment can be understood through the formula I = PAT (Environmental Impact equals Population size, times Affluence, or consumption per person, times Technology and resulting pollution.) Using I=PAT, scientist Paul Ehrlich calculates that the environmental impact of the average American is approximately 20 times that of a Costa Rican, 50 times that of a Malagasi, and 70 times that of a Bangladeshi.

Annual US population growth is about one percent, or roughly 2.7 million people. About 60 percent of this growth results from natural increase, with the remaining 40 percent from immigration. Applying the I = PAT formula and Ehrlich's calculations, 2.7 million additional Americans will have an environmental impact equivalent to some 54 million Costa Ricans, 135 million Malagasis, or 190 million Bangladeshis. According to United Nations Children's Fund, a child born in the US will, in his or her lifetime, have an environmental impact more than 250 times greater than that of a child born in Sub-Sahara Africa.

Environmentalists note that lifestyles and patterns of consumption largely determine the extent of resource exploitation, waste generation, and environmental damage inflicted by any given society. According to Union of Concerned Scientists, the US, with under five percent of the world's total population, uses 25 percent of all oil, 23 percent of all coal, and 27 percent of all aluminum. The Natural Resources Defense Council estimates that Americans also consume one-third of all paper and generate nearly three-quarters of the world's toxic waste.

Americans own roughly one-third of the world's automobiles, drive about as many miles as the rest of the world combined, and are far and away the largest per capita producers of carbon dioxide - the primary greenhouse gas. The typical American also produces nearly a ton of garbage each year, uses roughly two and one-half times as much energy as the average Japanese. and have more shopping malls than high schools.

US growth from natural increase constitutes less than two percent of annual global population increase. But in terms of impacts, Americans consume resources, generate waste and inflict environmental damage on a scale far beyond their numbers.

US Population Growth and Quality of Life

Not all of the population-related impacts in the United States are suffered by the natural environment. The lifestyles and social health of Americans are also significantly degraded by impacts associated with overpopulation. The Fordham University Index of Social Health - which monitors 16 indicators of social well-being, including infant mortality, children in poverty, access to affordable housing, average weekly earnings, homicides, high school dropouts, and the

The American "Footprint"

Every person has an eco-logical or environmental "footprint." At the most basic level, we all need enough productive land to produce food and fiber and enough clean water to drink, wash and irrigate. We also need enough land to supply energy for heat and cooking, provide some sort of employment, and dispose of our wastes.

As people's lifestyles expand, so do their footprints. In the industrialized world, we need more land to support our more protein-rich diet, and to supply resources to build our homes, schools, factories, shopping centers and offices. We also need materials to supply the production and con-sumption of consumer goods that make up the bulk of our economic activity.

In the United States, the average ecological footprint is the largest in the world- some five hectares (12.6 acres.) As large as the United States is, ecologically productive land is limited, so as US population expands, per capita availability of ecological land decreases. In 1995, the United States had only about 2.8 hectares (6.9 acres) of ecologically productive land per person, leaving a deficit of roughly 2.2 hect-ares (5.4 acres). To support the typical American lifestyle, the US has to import products from (and sometimes export wastes to) other areas.

On a global scale, there is only about 1.5 hectares (3.7 acres) of ecologically productive land per person. If everyone in the world had a footprint equal to that of an American, we would need over two more planets to support us all today. At current growth rates, we would need five more planet Earths to support the world's population in 2050.

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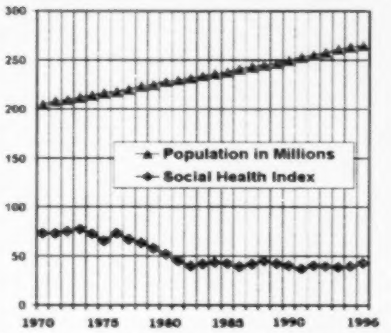
gap between rich and poor - declined 41 percent between 1970 and 1996. It is significant to note that this decline continued through economic expansions and recessions, and through Democratic and Republican administrations. It also occurred despite a near doubling in Gross Domestic Product during those years.

US Population vs. Social Health



Data from Fordham Institute for Innovation in Social Policy and US Census Bureau. Graphic by Facing the Future.

In that same period, the number of people living in poverty rose by over 50 percent, and included more than one-fifth of all US children. What is particularly significant is that due to a decline in wages - which is linked to an excess of workers due to both population growth and increasing mechanization - a number of working people have been pushed into poverty. In 1995, the share of US workers earning below-poverty wages reached 30 percent.

Studies have also indicated a correlation between increasing population and a number of other concerns, including crime and drug abuse. According to the Bureau of Justice Statistics, crimes of all types, as well as the percentage of people in prison, have soared as America has become more populated and more crowded. Road violence - incidents of assaults and shootings by drivers in traffic altercations - increased by more than 50 percent between 1990 and 1995, resulting in over 200 deaths.

Another indicator, the Genuine Progress Indicator GPI, developed by the policy organization, Redefining Progress, profiles a similar trend. The GPI includes more than twenty economic indicators that the traditional indicator of economic progress, Gross Domestic Product, (GDP) ignores. It adjusts for factors such as income distribution, adds others (such as the value of housework and community work), and subtracts still others (such as pollution costs and resource depletion). "The result," according to Redefining Progress, "is a balance sheet for the nation that starts to distinguish between the costs and benefits of 'growth.'" By this "balance sheet," GPI has declined in the US by some 45 percent since 1969, despite a rise in GDP of some 45 percent over that same period.

Environmental degradation caused by overpopulation and high consumption in the US contributes significantly to a lower quality of life for many Americans. Because of groundwater pollution, roughly one out of every five Americans is dependent on water contaminated by lead, toxic chemicals, or fecal bacteria. Because of air pollution, more than 60,000 Americans die prematurely each year from cardiopulmonary conditions.

The United States has lost 55 percent of its wetlands, 95 percent of its old growth forests, and 99 percent of its native prairies. More than 500 plant, animal, and other species have already disappeared in the US, and over 1,400 more are currently listed as endangered or threatened. Habitat and farmland continue to disappear as population growth forces conversion of open space to human uses. And because of urban / suburban "sprawl," an area the size of the state of Delaware is paved over every year.

Hunger and Homelessness in the US

In 1998, as in every year that the US Congress of Mayors has surveyed hunger and homelessness in America's cities, the over-all demand for both emergency food and shelter increased. Requests for emergency food assistance increased by 14 percent, and demand for emergency shelter increased by 11 percent.

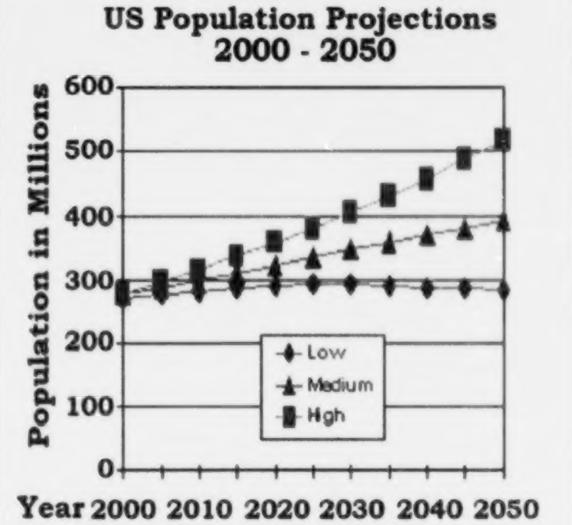
On average, the Mayors reported, 21 percent of requests for emergency food were unmet, as were 26 percent of requests for emergency shelter. Almost half the survey cities had to turn hungry people away due to lack of food resources, and over two-thirds of the cities were unable to meet demands for emergency shelter. Over 90 percent of cities reported that emergency food assistance was relied upon by families and individuals both in emergencies and as a steady source of food over long periods of time.

Some 37 percent of people requesting food assistance were employed, and officials estimated that 38 percent of the homeless were families with children. Underlying these problems, the Mayors reported, are low paying jobs, unemployment, cuts in food stamps due to welfare reform, poverty or lack of income, high housing costs, low benefits in public assistance programs, and substance abuse.

City officials reported that the strong economy had very little positive impact on hunger and homelessness. Of reporting cities, 96 percent expected requests for emergency food to increase in 1999, and 93 percent expected emergency shelter needs to increase.

The Future of US Population

While the US inflicts a significant amount of damage on local and global ecosystems - and Americans suffer the impacts of declining social and environmental health - there seems little prospect of alleviating these impacts if current trends continue. With a natural increase rate among the highest in the industrialized world (second only to Australia) and continuing high levels of immigration, US population is expected to increase even more dramatically in the future. Unless sustainable population, development, and environmental protection policies are implemented - and policies that subsidize waste, over-consumption, and destructive practices are reversed - long-term projections indicate a continuing decline in well-being for most Americans.



Depending on the decisions we make in the next few decades, US population could range from around 280 million to as high as 515 million.
Data from US Census Bureau.
Graphic by Facing the Future.

And the Answer Is . . .

A study by the State University of New York concluded that every baby born in the US would, in his or her lifetime, produce one million kilograms of atmospheric wastes, 10 million kilograms of liquid wastes, and one million kilograms of solid wastes. Based on current patterns, the study also concluded each new American would use 700 kilograms of minerals, and 24 billion BTU's of energy.

The report concluded that "the most effective way an individual can protect the global environment, and hence protect the well being of all living people, is to abstain from creating another human."

This is not a new concept. In 1974, the Rockefeller Commission was appointed by President Richard Nixon to study the impacts of population growth. Nixon's decision was based on concerns about declining quality of life in US cities and increasing environmental damage.

The Commission concluded that "no substantial benefits would result from continued growth of the nation's population" and that the United States should "welcome and plan for a stabilized population." It proposed adoption of policies designed to achieve and maintain replacement-level fertility (two children per woman) and capping immigration at 400,000 per year. The Commission also called for school-based population and sex education programs, promoting adoption, promoting women's rights through passing the Equal Rights Amendment, and providing universal access to family planning services.

These measures are no less important, and would be no less effective, today than they were in 1974. Supported by tax laws that encourage smaller families and focused anti-poverty measures, they could lead to population stabilization within a single generation.

Coupled with renewable energy systems, investments in education and infrastructure, increased taxes on pollution (and reduced taxes on income), and enhanced environmental protection, these actions could greatly improve the future quality of life in the US. With America leading the way in supporting global population stabilization through health care, education, human rights, and sustainable development, US citizens could look forward to a secure and sustainable future.

Sustainable Solutions

Personal Solutions
Control your own fertility, reduce you own impacts, get political, get educated

Policy Solutions
Reproductive health, education and empowerment of women, human rights, poverty eradication, sustainable livelihoods

Reversing the Trends
Dealing with food security, water availability, and income inequity

Protecting the Environment
How to sustain forests, fisheries, biodiversity, and the atmosphere

Building Sustainable Economies and Communities
Creating a new score card, rethinking priorities, investing in people, addressing "push – pull," rewriting the tax code

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This section offers overviews of solutions - personal and global - to the increasing impacts of human numbers and lifestyles. Obviously, these issues are complex, and implementation of solutions will vary with different cultural, economic, geographic and political realities. We are not suggesting that, "One size fits all." However, the fundamentals of creating sustainable populations, economies, and communities are constant - physical and social health, education, equity, human rights, and sustainable livelihoods. Specific technologies, delivery systems, and decision-making processes will vary by context. What is essential in any context is that solutions be just, humane, and culturally appropriate.

The following pieces highlight key solutions to the most pressing issues we confront. Our intent is not to offer an in-depth examination of each solution. Instead, we have tried to provide a context for exploring these solutions in a holistic manner. For a more detailed look at solving any specific issue, we recommend researching through the listings in the Recommended Readings of this Guide, or through our World Wide Web presence at **www.facingthefuture.org**.

Personal Solutions

When confronted by the issues of world population growth and the resulting impacts, many people feel overwhelmed and powerless. The problem seems so overwhelming that they don't believe they can do anything about it. But individuals can, and must, make a difference.

At Facing the Future, we like to use the example of a mobile hanging from the ceiling. Even though it appears that the pieces hang in isolation, they are completely interconnected. Even a slight pull on any individual piece causes all the others to move. This is exactly how small problems or seemingly insignificant actions can have a large impact, and how seemingly small solutions can effect positive change in a number of areas. It is important to remember that relationship, and understand the power of the personal choices you make - whether positive or negative - in the larger view.

Control Your Own Reproduction

The first and most important thing you can do to stabilize world population is to control your own fertility. This means having two or fewer children. Not having any children - being "childfree" - is also a realistic option. If you want - and can adequately care for - more than two children, you can adopt. Limiting fertility is important because each person has an "environmental footprint." The larger the footprint of the human community on the Earth, the less remains for the natural world.

How fertility is controlled is a very personal choice, with options running from contraception or sterilization, to abstinence. If you're uncertain about the most appropriate method, a number of organizations such as Planned Parenthood of America can help explain options. There are also a number of informative sites on the Internet, many of which are listed on the Facing the Future web presence under "References and Links."

Having two or fewer children is one of the most important things any couple can do to stabilize world population. Image copyright©1997 - PhotoDisc, Inc.

Reduce Your Own Environmental Impact

There are a number of ways to reduce your own environmental impact, from recycling, using fluorescent light fixtures, and driving less, to planting trees and restoring wildlife habitat. It sounds simple, but even such small steps as turning off the lights when leaving a room and turning down the thermostat on the house or water heater can help. Conserving energy means less energy has to be generated. Less fuel is burned, and fewer emissions are released into the atmosphere, reducing smog and slowing global warming. Buying a more efficient car not only saves energy and reduces pollution, but also saves you money. Walking or riding a bike instead of using a car for short trips is both energy-efficient and healthy.

Cut down on the amount of garbage you generate. Recycle everything you can, and see if a local thrift shop or charity will take items that you have no use for, instead of throwing them in the trash. Start "pre-cycling" as well, buying only products in recyclable or reusable containers, and limiting purchases of products with excessive packaging. Start a compost pile for your yard or garden to keep food scraps and yard wastes out of landfills, and to build up soil and fertilize plants.

Recycle, precycle, bicycle! Lowering our individual impacts helps reduce the overall human footprint on earth. Image©1997

Save water by fixing dripping faucets, installing low flow fixtures, and not leaving the water running while brushing your teeth. Even those simple steps can save thousands of gallons a year. Learn about natural landscaping with indigenous plants that require less water, and consider replacing lawns (a major cause of water use, as well as pesticide and fertilizer applications) with drought-resistant ground covers.

One way to approach this is through "simple living." Practiced to some extent by tens of millions of people around the world, simple living is a way of life focused around frugal consumption, ecological awareness, and personal growth. Simple living advocates report that with fewer material needs, they require far less money and are able to work less. The time gained is spent enjoying family, friends, recreation, and community service. Overall, they enjoy a higher quality of life than they did while working more and consuming more.

Become Politically Involved

Bringing the issue of population into public and political consciousness is extremely important. Write a letter to the editor of your local newspaper outlining population issues and impacts. Contact your elected representatives and express your concern. Work to make population a cornerstone of national political choices. Let your leaders know how you feel about these issues, and express it at the ballot box. Vote and volunteer for candidates for political office who support sustainability, reproductive health, and environmental protection.

And remember to think about the larger picture. If we want to help save the rainforest, it's very much about the choices we make in our own countries. By electing officials who support reproductive health care assistance, we can help poor people in developing regions control the size of their families. Since poor people are disproportionately involved in clearing the rainforest to support their families, this would be a tremendous step toward preserving the forest. Also, if we focused our foreign assistance on educating girls, sustainable development, and promoting structural reform (rather than supplying arms), we could reduce birth rates, ease pressures on the environment, and improve the quality of life for all people.

Support Positive Change

Learn about and support environmentally sound industries and technologies, such as sustainable agriculture, sustainable forestry, and renewable energy. Support those activities whenever possible in your community.

It may be necessary to help create positive options. If there isn't a recycling program in your community, for example, talk to local officials and businesses about starting one. If "green" forestry products are not available from your local lumberyard, encourage the owner to stock and promote such materials.

If pre-cycling is hard to do because of a lack of environmentally friendly products, write to the manufacturers of the products you use most, and ask them to introduce more "eco-friendly" products. Tell them you'll ask your local merchants to carry those products, and will buy them (and even pay more for them) if they're available.

If people support environmentally sound products and services, sales of those products and services will increase. As businesses see sales increase, they will shift production and merchandising to accommodate that growth. If significant numbers of consumers decide to buy more fuel efficient cars, for example, auto manufacturers will respond by producing more fuel-efficient vehicles.

On a global level, learn about and support programs to educate and empower women, and to deliver reproductive and community health care. Support programs to help people achieve economic security in a sustainable manner, along with programs to promote human rights.

This is important in selecting which groups to support with your charitable donations. Consider focusing your giving on groups that provide reproductive health care and education, such as the International Planned Parenthood Federation, or Pathfinder International. If you prefer to make a charitable contribution to support sustainable development, consider making it to an organization like Grameen Bank or the Heifer Project, where it will directly benefit women in the developing world, and help them achieve the financial status that is associated with lower fertility.

Educate Yourself and Your Friends

Educate yourself about the problems we face. Learn how various actions and impacts interact, and explore the connections between population trends, economic and social systems, and regulatory and legislative structures. Be aware of the consequences of your actions on a larger scale. If you leave the lights on, for example, somewhere a power plant or hydroelectric dam must burn more fuel or release more water through the turbines to supply that electricity. The end result is more pollution or disruptions of fish stocks.

It's hard to pick up a newspaper and not identify half a dozen issues that are directly caused or multiplied by population growth, but we almost never find that covered in the story. (Biologist Garrett Hardin says population discussions are "taboo" in most societies around the world.) If people can be made aware, in a positive way, of the connections between human numbers and lifestyles, and key environmental, economic and social issues, then those issues can be discussed and addressed.

Work With Others

Support at least one environmental organization. If you can support more, do so. Choose a group working on the issues most important to you, and become involved in their programs. If you can't afford to give money, give time. Help with mailings, phone trees, or petition drives in support of causes you care about.

Become a member of a population education organization such as Population Action International, the Population Reference Bureau, or Zero Population Growth. Share their materials with others. Not only will your efforts boost the groups you work with, they'll also help build community. Realizing that none of us is in this alone, and that we can make a difference, is empowering, and builds hope.

When working to protect the environment, stabilize population and improve the quality of people's lives, it's important to remember that every effort you undertake is part of a larger context. René Dubos perhaps said it best when he coined the phrase, "Think globally, act locally." Every contribution in your own community has a ripple effect that can spread across the planet, and support other efforts.

Global Solutions

Looking at global solutions, it's essential to remember that stabilizing population will help solve the environmental, economic, social, and security problems we confront. The most important solutions - virtually all of which could be implemented on community or regional levels - would be:

- Universal access to quality, affordable reproductive health care, including family planning
- Investment in community health care to significantly reduce infant, child and maternal mortality
- Broad-based and integrated measures to insure gender equality and empower women
- Universal access to education with a special emphasis on educating girls
- Universal protection of human rights
- Integrated anti-poverty efforts
- Environmental protection and restoration efforts
- Conservation and enhancement of key renewable resources
- Development of sustainable technologies (especially energy) and transfer of those technologies to developing regions
- An overhaul of tax systems to encourage things we want and discourage things we don't want.
- Revising the indicators by which we measure growth and progress

Obviously, most individuals can't effect these solutions on their own. But they can help raise awareness, promote discussion, and influence local, regional and national political decisions. Individuals can support groups involved in sustainability work, lobby their representatives to support and fund that work, or participate in that work as a volunteer. They can also invest in businesses pursuing sustainable solutions.

Promote Reproductive Health

The most fundamental and essential solution to stabilizing population (and solving the associated environmental, economic and social concerns) is providing affordable, accessible reproductive health care worldwide. If people have access to family planning services, they can control both the number and spacing of their children. Nearly 230 million women worldwide are in need of modern contraceptive methods to postpone or avoid future childbearing. If those services were delivered and unwanted births were prevented, world population growth would fall by some 20 percent almost immediately.

Providing reproductive health care (as in this Morroccan Clinic) allows people to choose the number and spacing of their children. In addition to helping stablize population, reproductive health care significantly reduces child and maternal mortality. FAO Photo.

Investing in reproductive health is very inexpensive compared to environmental damage, or trying to create security through arms buildups and conflict intervention. It is also incentive-based, because it enables people to freely choose the number and spacing of their children.

Reversing the Trends

Some of the most fundamental indicators of human well-being - farmland, fresh water, forested area, and fisheries - are declining on a per capita basis. The single most important long-term solution to increasing scarcity is stabilizing population. Technological improvements can certainly help, but a sustainable population is the first and most important component of a sustainable world.

That said, there are a number of structural and technological solutions that can be implemented almost immediately - and many more that can be created in the near future - to help assure social health and security, and to help stabilize population.

Addressing Food Security

An integrated approach is needed to stabilize population and increase both the supply and availability of food. It's important to recognize that world food supplies today - estimated by the United Nations Food and Agriculture Organization (FAO) at 2,700 calories per person per day - are sufficient to feed the world's current population. The widespread hunger that afflicts as much as one-fifth of the Earth's people is due to distribution and structural problems rather than production shortages.

(There is not enough food to feed the world's population a North American diet, however. Americans consume about 3,600 daily calories through a diet heavily dependent on animal protein. If all six billion of us were to somehow adopt an American diet, we would immediately face global food shortages. But there is enough food available to feed everyone a healthy and nurturing diet such as that enjoyed in Italy.)

The solution to food scarcity - beyond stabilizing population, which is essential to long-term food security - begins with reducing waste. In middle to high-income nations, an average of 20 percent more food is produced than is actually consumed. In parts of Africa and Latin America, losses of cereal crops are sometimes as high as 50 percent. The US Department of Agriculture studies indicate that more than one-quarter of all food produced in the United States is tossed out unused, or goes uneaten on the plate.

Food distribution also needs to be addressed. Many areas of the world where population growth is greatest lack adequate food production resources and technologies. Transfers of appropriate technologies and investment in agriculture in those areas are extremely important.

Addressing poverty is an essential part of achieving food security. Although the percentage of hungry people around the world has dropped in the last 20 years, the absolute number of hungry people has grown due to population increase. In many areas, poor people simply can't afford adequate nutrition. Even though they may be net food producers, poor people in rural areas are often forced to sell their food to generate cash, whether to help them through times of poor harvests or crop failures, or to pay rents or mortgages. Anti-poverty programs - from education to micro-lending and community-based economic development - are an essential component of food security, as is access to land for smallholders. Debt relief for developing countries is also important, because many poorer nations are forced to export food to service their debts, despite widespread hunger among their people.

Sustainable production methods are also key to both food security and environmental protection. Current food production practices rely heavily on mechanization, monoculture, irrigation, pesticides and fertilizers. These too often result in soil erosion and depletion, waterlogging or salinization, biodiversity declines, and ground and surface water pollution.

Sustainable agriculture is one response to this. Sustainable agriculture builds healthy soil and selects plant varieties suitable to local conditions and resistant to pests. Crop rotations, inter-cropping, and soil-enriching cover crops are used to lessen the need for synthetic fertilizers and to reduce soil erosion. Moreover, by avoiding pesticides, sustainable agriculture allows the return of microbes and insects to the soil, which both increases soil health and helps crops resist pests.

Mango processing in Guinea. Affordable, small-scale technologies for processing and preserving food can boost nutrition and provide sustainable livelihoods for women. FAO Photo by R. Faidutti.

Urban agriculture - essentially the production of food in towns and cities - is another system that can increase food security, help restore local environments, and strengthen urban economies. Urban agriculture can be as simple as a family supplementing their diet by raising chickens in a back yard pen, fish in an artificial pond, or vegetables on a porch or rooftop. It can be as complex as a community garden that helps feed a neighborhood, or a commercial hydroponic vegetable farm in a warehouse.

Because a high percentage of those involved in urban agriculture are women, this process also helps address gender equity in food distribution. Other benefits of urban agriculture include use of urban solid waste and waste water for food production (strictly monitored for quality control and public health) and compatibility with land uses such as residences, commerce, transportation, and utilities. Urban agriculture can be supported through enlightened land use and zoning laws that encourage sustainable food production, and through funding for micro-development.

Another key to both increasing food security and stabilizing population is empowering women. United Nations Population Fund studies indicate that women produce the majority of food for family or local consumption (and roughly half of our global food supply). Studies indicate that, given the opportunity to make household decisions, women devote more income to maintaining better nutrition for their families, and are also more prone to set aside money for education and health care.

Protecting farmland from development is also essential. Because of the needs of expanding human populations, productive land in much of the world is being paved over at alarming rates. To counteract this trend, national, state and local governments can enact policies to protect farmland, including comprehensive land use planning and farm-friendly zoning, such as "cluster" development, agriculture protection areas, and "right-to-farm" ordinances. Tax structures that encourage conservation of farmland rather than its development are also necessary.

An end to subsidies and price supports that encourage unsustainable farming and forestry methods is also essential. In many parts of the world, governments pay producers (often large corporations) to continue farming techniques that damage soil or overuse water. In the US, subsidies encourage producers to raise crops (such as tobacco and corn to produce ethanol fuel) that are either resource-intensive, or extraneous to food security.

Addressing Water Scarcity

Because of population growth, per capita availability of fresh water has declined by over 57 percent since 1950. On the other side of the equation, per capita consumption has increased by some 50 percent since 1950. As with food production, the only real, long-term solution to water scarcity is stabilizing population, but we can effectively buy time to achieve that end.

Because fresh water supplies are fixed by the hydrologic cycle, conservation and reuse are the essential components of water security. (Distilling seawater is not a viable option at this point. That process requires massive energy inputs, which at this point could only come from nuclear or hydrocarbon-powered generation, which create additional problems.)

Worldwide, almost two-thirds of water withdrawals go to agriculture. Industrial uses consume just over one-quarter, and municipal uses make up just under one-tenth of the total. During this century, agricultural water use has increased by six times. Industrial use has increased by 30 times, and municipal use has increased by 26 times. (Figures given here are for the world. The ratio of industrial to agricultural uses is reversed in most industrialized nations, because so many manufacturing processes - such as paper, steel and petrochemical production - are water-intensive.)

Because agricultural uses are by far the largest percentage of the Earth's fresh water, increasing irrigation efficiency is a top priority. Worldwide, irrigation is estimated to be only 40 percent efficient, meaning that more water is wasted than is actually delivered to crops. These losses can be limited by changing the means of water delivery and application. Better soil monitoring - so that irrigation is applied only when necessary - is another solution, as is planting more drought-resistant species.

Reuse of industrial and municipal wastewater for agriculture also holds promise. Most municipal water in the industrialized world - whether "gray" water from sinks and showers, or "black" water from sewer systems - is processed at sewage treatment plants where solids are removed. After a series of treatments, the water is most often discharged into rivers, lakes or oceans.

Instead, that water can be used for irrigation. Separate gray water systems could be incorporated in future construction that would allow household wastewater to be used for gardening purposes with minimal treatment. Eliminating some of the treatment steps at sewage treatment plants would leave some organic nutrients in the water that would be beneficial for agricultural use. Both options would save money for water users and taxpayers and, in many cases, help keep sewage out of rivers, lakes and oceans.

Industrial water recycling and reuse is another area with great potential. Most water used in industrial processes is not consumed, but is used for cooling, cleaning or processing materials, then discharged. Often, during the manufacturing process, a variety of pollutants are introduced into the water. Recycling and reusing that water not only saves water, but also is often the least expensive way to meet pollution standards. Some industrial operations have been able not only to cut water use by 90 percent, but also to meet strict pollution standards, and save money in the process.

Most of these technologies are absent in the developing world, where water waste and pollution remain serious problems in agriculture and manufacturing. A combination of investment and technology transfers from industrialized nations, along with local regulation and enforcement, could save water, protect aquatic environments, and promote public health in those regions.

A wide variety of conservation techniques are available to municipal water users. Some of the most effective are upgrading inefficient or leaking distribution systems, and creating incentive programs that encourage users to switch to lower use fixtures in homes and businesses. More efficient irrigation of community parks and facilities can save significant water, along with rate structures that encourage conservation, and education programs that help the public make informed decisions about water use.

Finally, changing the way we view water - not as an unlimited convenience, but as a valuable resource - is central to addressing scarcity. For much of human history, water has simply been viewed as a tool for development. But water resources are finite, and must support both a variety of human needs, and complex ecological systems. A "water ethic" is necessary to assure that water is used wisely and equitably. Such an ethic would consider and value environmental and human needs, and meet those needs in an integrated, holistic way. It would serve as a guide to the equitable distribution of water resources between and within natural and human communities.

Addressing the Income Gap

The correlation of poverty, environmental destruction, declining social health, and higher fertility is well documented. In order to achieve a sustainable population, it is clear that human well-being must be improved. And in order to do that, the growing gap between rich and poor nations - and rich and poor individuals - must be addressed.

Closing the gap between rich and poor begins on an international level with a refocusing of assistance programs. Much of the international aid that flows from rich to poor nations today is in the form of arms and military aid, food aid, or aid for large-scale development projects. It is also often tied to short-term strategic interests of donor countries, and therefore often does not focus on community development to increase well-being. Foreign aid has also been declining this decade, both in terms of real dollars, and as a percentage of donor nations' GDP, primarily due to aid reductions by the United States.

In order to create broad-based economic growth and reduce poverty, aid must focus on expanding human capacity. Key areas for investment include reproductive and community health care, education and training, sustainable community-based development, and access to credit. Infrastructure development such as clean water and sanitation, housing, and transportation must be included, and governmental capacity must also be expanded.

New development models must be part of this investment. Simply promoting traditional development strategies that are highly resource-intensive and fossil fuel-based will only increase global environmental damage. New, efficient, non-polluting technologies should be transferred to developing regions. To improve communications, for example, cellular technology can be employed, rather than hard-wired telephone systems. Transportation systems can be created in concert with land use planning that maximizes community and efficiency, and minimizes environmental impacts. And energy systems can use renewable, non-polluting technologies.

In order to increase equity within nations, many of the same methods will prove highly effective. Investing in human capacity through education and training is essential. So is investing in services such as reproductive and community health care, and sustainable agriculture and manufacturing.

One final key to solving the interrelated issues of population, poverty, environmental destruction, declining social health, and conflict will be working hard to overcome gender and social discrimination, racism, and religious intolerance. Until all members of any society have equal access to educational, social and economic opportunity, inequity will continue to inflict negative impacts on individuals, societies, and the planet.

Sustaining the Environment

Just as with all the other key issues we face, environmental protection and restoration are totally dependent upon stabilizing human numbers. This, in turn, is dependent on providing reproductive health care, reducing poverty, and empowering women. Reducing overconsumption and waste - often driven by fashion - in much of the industrialized world is also vital.

Most difficult of all, it is dependent upon all of us learning to view the natural world in a new way. If we really want to protect and restore the environment, we will no longer be able to view it as a disposable commodity that can be chopped down, dug up, or dumped on to raise cash. We must instead see it for what it really is - our life support system and the basis of our entire economy.

Cooking on an improved stove in India. Energy- efficient stoves can save fuelwood, reduce the amount of time women spend gathering wood, and improve health through reduced emissions. FAO photo by A. Olstad.

Saving the World's Forests

Evolving a new world view lies at the heart of sustaining the world's forests. We now know that forests are home to perhaps half of all the world's diverse species, and that they help stabilize climate, clean the air, prevent floods, and limit erosion and siltation of streams, rivers and estuaries. But our laws, economic systems, and social conventions view forests as a disposable resource, to be harvested as required to create or retain jobs, service debt, or generate quarterly dividends.

The first step in saving the forests is the implementation of sustainable practices. This means the resources must be managed in a manner that allows the preservation of the planet's remaining primary forests, and the restoration of other forest areas. Current practices of clearing forests for farmland, or a one-time profit on timber, should be banned.

Lifestyle issues must also be addressed, because consumption of wood and paper products have increased considerably faster than population during the latter half of this century. Sustainable consumption is essential to promote sustainable production.

Eliminating waste in timber harvesting and processing is a solution that can be implemented almost immediately. Because of harvesting and processing techniques, half or more of the trees cut in logging operations are often wasted. One study in Brazil indicated that only one-third of each harvested log was turned into lumber. The rest was simply discarded. If all the wood wasted in harvesting and processing were to be utilized, the United Nations Food and Agriculture Organization estimates that consumer demand could be met while preserving the forests.

Eliminating waste in packaging would dramatically reduce the number of trees needed to meet consumer demand. About one-third of all waste in America is packaging, most of which is unnecessary to protect the product it encloses. Far more packaging than necessary is used simply to make products more visible on store shelves.

Revising economic policies to account for the true value of forests is vital to forest preservation. If businesses and consumers had to pay the true costs of forest products, they would be much more likely to conserve. Not only must forests be valued for their biological functions, the negative impacts of their destruction must also be factored in. To calculate the true price of timber from a given harvest, the cost of increased pollution, flooding, siltation and biodiversity declines must be added in, along with the loss of recreational opportunities. Subsidies that encourage timber harvests by suppressing true costs - such as the building of roads with tax dollars by the US Forest Service so timber companies can harvest national forests - must also be eliminated.

Protection for forests should come, in part, from changes in the legal and land ownership arenas. Many forests are owned by national or state governments that have minimal interest in maintaining the health

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of the forests and surrounding communities. Devolving control of forests to local communities can not only help ensure better management, but also improve local quality of life and economic opportunity. Community control of forest resources is especially important in the developing world, where improved community health and economic opportunity are closely tied to lower fertility.

Other solutions to deforestation include increased recycling of wood and paper products, especially in the business community, which lags behind the general public in recycling. Fast-growing renewable plants such as industrial hemp can also replace wood products in paper and fiber production, and their production can boost rural economies. Focusing development aid on sustaining forests - and away from building large dams, road systems, or agricultural projects that destroy large areas of forest - can preserve large tracts. And, conversion to renewable energy sources can help eliminate the pollution and acid rain that threaten many forests.

Preserving Biodiversity

The fundamental solution to halting biodiversity declines is halting population growth and overconsumption. As with all other environmental issues, species extinction is a result of human impacts. Our numbers and lifestyles compel habitat destruction, which is the number one cause of species loss.

Preserving biodiversity is also dependent on reducing poverty, because poor people are most often involved in clearing land for agriculture or to harvest fuelwood. People living in poverty are disproportionately involved in killing vertebrate species as well - whether because they compete for food, to eat, or to sell. And poor people are among the most frequent economic migrants to coastal areas, which contributes to coastal development and ocean pollution. Increasing human capabilities through education and training and creating sustainable local economies are essential components of preserving habitat, and protecting individual species.

Ending subsidies that encourage habitat destruction and overharvesting is another top priority. Worldwide, hundreds of billions of dollars are spent to subsidize farming, forestry, fishing, mining and energy use, all of which negatively impact the environment and contribute to biodiversity declines. (This, of course, also prevents that money being spent on positive things, like health care, education and environmental restoration.)

Most often these subsidies are given in the name of providing employment or economic growth, or holding down prices. What they promote instead is waste of critical resources, destruction of local ecosystems, and sometimes global environmental impacts. They encourage consumption of products because prices are kept artificially low, and often shift income from poor and middle class taxpayers to corporations and wealthy individuals.

Marine ecosystems require particular attention to preserve biodiversity, because almost half of the Earth's animal phyla are exclusively marine. Overharvesting, pollution, coastal development, and introduced species are all damaging that diversity.

Coastal development is considered by many environmentalists to be the most pressing marine issue. Over half the world's population lives within 100 kilometers of coastlines, and almost one fifth of the world's population is located in coastal cities. This is accelerating as poverty drives poor people to cities and coastal regions. The result of all these trends is accelerating destruction of coastal and estuarine habitats.

Obviously, working to stabilize population and eliminate poverty are key to curbing coastal development. So are land use regulations that preserve natural areas and require setbacks from shorelines. And, as in many other areas, elimination of subsidies that promote coastal development should be prioritized. These include port development, dredging, dikes, breakwaters, and flood control, all of which disrupt natural systems and encourage coastal development.

Most marine pollution results from land-based activities, such as run-off and discharges of chemicals and silt, and airborne pollution. Implementation of sustainable agriculture, forestry, and industrial practices will address many run-off issues. Increased investment in treatment of sewage, wastewater and stormwater can solve many of the problems associated with municipal pollution. Airborne pollution must be addressed as part of atmospheric solutions, as outlined below. All of these efforts should be part of an integrated strategy to improve human well-being through improved air, water, and food quality standards.

Overfishing can be addressed first by reducing the world's fishing fleet, and the subsidies that maintain it. That fleet today is twice as large as is needed to harvest the world's fisheries sustainably. That excess capacity - and the subsidies that sustain it - cause fishers to compete harder for declining fish stocks, and drive the continuing decline of those stocks. Shifting subsidies (which total over $50 billion worldwide) to reducing rather than enhancing fleets is the first step. Vessels, equipment and licenses can be "bought back" - as has been done in Canada and parts of the United States - to reduce the number of fishers and the pressure on targeted fisheries. This is an attractive financial option as well, because buybacks are a one-time cost, while subsidies for boat purchases, electronics equipment, fuel, and port infrastructure are ongoing.

Reducing "by-catch" and waste is also vital. As much as one-third of the total catch is made up of non-targeted species, most of which are discarded. Since much of this by-catch is immature fish, future stocks are severely damaged by this process. High levels of by-catch also decrease the natural food supply for other species, causing declines in those species.

Negotiating new international agreements - and budgeting the necessary money to enforce compliance - is another key. Since the open oceans are viewed as a "commons," fishers now have an incentive to harvest as much as possible, because they are in competition for the resources. Creating exclusive fishing zones encourages nations to defend those zones from disruption, and harvest them sustainably. Devolving control of fisheries to local jurisdictions can also help. If fishing areas are clearly delineated, the communities dependent upon each area have a vested interest in protecting them not only from overfishing, but also from degradation by pollution and shoreline development.

Clearing the Air

No environmental issue poses a greater long-term threat to human security and the health of ecosystems than atmospheric pollution. In its various forms, atmospheric pollution causes smog, acid rain, ozone depletion, and greenhouse gas concentrations that are linked to global climate change. All of these in turn have profound impacts on the health of human beings, and of ecosystems. While appearing only on a relatively modest scale today, these impacts are expected, in the longer term, to threaten food and water security, biodiversity, and the homes and livelihoods of billions of people in coastal areas that may be inundated by rising sea levels.

Wind energy has the potential to produce five times as much power as the world currently consumes. It is renewable, non-polluting and adaptable to large or small-scale production.

As with all other solutions, clearing the air begins with creating a shift in perspective. Our historical dependence on fossil fuels - which today generate some 85 percent of the world's energy supply - is clearly linked to our models of development. But just as water power gave way to steam power, and steam gave way to internal combustion and electricity, it is now time to move away from fossil fuels.

Fortunately, most of the technologies necessary to create a sustainable energy economy already exist. Many are already competitive with fossil fuels, and more will become so once subsidies that support fossil fuel consumption are eliminated. What's missing at this point is the mental shift toward renewable energy. Rather than viewing sustainable energy as a threat to the global economy, we must recognize the tremendous opportunity it offers to protect human health and the environment, boost employment, and increase economic options for the industrialized and developing worlds.

The first step to reducing carbon emissions is increasing the efficiency of existing users. An excellent starting place is with the transportation. Currently, over one-fifth of all energy-related carbon emissions come from vehicles. The world vehicle fleet has increased tenfold since 1950, and is projected to double again by 2025.

Technology currently exists to greatly improve vehicle fuel economy and, therefore, lower emissions. (No matter how "clean" vehicle exhaust is, burning fossil fuels emits carbon dioxide, the primary greenhouse gas. To produce less carbon dioxide, we need to burn less fuel.) Toyota has already announced a high-mileage, low-emission automobile, and other manufacturers are poised to do the same, if consumers respond favorably. Electric vehicles, hybrid electric, and fuel cell-powered vehicles are all realistic options if market forces support them.

To encourage market support, however, governments will likely have to create incentives. Today, in many industrialized nations, there are numerous incentives in place to encourage fossil fuel consumption (and thus increase emissions) and disincentives to conserve. Worldwide, an estimated $200 billion is spent every year subsidizing conventional energy production and consumption. Subsidies come in the form of tax deductions and credits, investments in road expansion and construction to support vehicle traffic without offsetting user fees, and artificial suppression of electricity and petroleum prices.

These subsidies should be shifted to support research and development, and infrastructure development of renewable energy sources, such as wind, photo voltaic, geothermal, and biomass. Some of these policies are already in place in Europe and Japan, and are beginning to appear in the United States, but their application must be accelerated.

Another area for immediate efficiency increases is energy use in structures, which now accounts for 29 percent of carbon emissions from energy use. Simply shifting to compact florescent light bulbs from incandescent bulbs could lower energy consumption for lighting by some 75 percent, while producing the same amount of light.

Compact florescents - or the even more efficient metal halide lights now being developed - could be mandated by a simple change in building codes. The higher initial costs would be more than offset by the energy savings and far greater longevity of the new bulbs.

Switching to more efficient appliances in homes and offices would also save energy immediately, and money over the long term. More energy-efficient models of common appliances in the industrial world - such as refrigerators, washers, computers, heaters and air conditioners - are already available. Improved insulation holds great promise for energy savings, as do small-scale heating and cooling plants in office, industrial, and multi-family residential buildings, and building-generated electric systems.

The prospect of co-generation - a process in which heat and electricity are generated together on-site - holds the potential to lower fuel use considerably in larger buildings. All these increases in efficiency could be addressed through building and development codes.

It's important to note that many such efficiency codes exist today, but are often unevenly applied. Allocating resources to a fair and effective enforcement system - and providing supplemental assistance to help poorer individuals and communities comply - will be necessary components of programs to increase energy efficiency.

Small-scale renewable energy technologies are also available and, with tax and policy support, could be quite competitive. In Japan, rooftop solar systems power a small but increasing number of individual homes, with the government paying half the cost of installation.

Wind generation - which can be harnessed by both single family homes and commercial installations - has the potential to supply five times the world's current electrical use. Geothermal energy can be used both for heating and electrical generation. And biomass generation - which uses methane gas from organic materials - is appropriate in rural or urban settings. All these technologies can be applied not only in industrialized regions, but also in rural villages of the developing world.

These technologies could be brought on-line in the very near future with a considered mix of tax credits, research and development incentives, market guarantees, and technology transfers. These should occur alongside a gradual phasing in of a carbon tax to discourage consumption of fossil fuels. In order to keep that tax from being a burden on the economy and the poorer members of society, it should be part of a complete tax restructuring to shift taxes away from things we want (like income and investment) and on to things we don't want (like pollution and resource depletion.)

Finally, agreements must be negotiated with industry, which accounts for 45 percent of world carbon emissions from energy use. These agreements - which would also require monitoring and enforcement procedures and funds - would mandate industry to incorporate energy-efficient technologies into its manufacturing processes and plants.

A carefully worked out schedule - combined with appropriate tax and investment incentives - would allow these to be implemented over a reasonable period of time to interface with normal plant and process updates, and allow cost recovery. Over the long-term, these adjustments would increase both productivity and profits.

The combination of all these adjustments - implemented in an integrated and holistic manner - would shift the world from a destructive fossil fuel-based energy economy to a sustainable energy economy over a few decades. The benefits would include clearing the air, improving human and ecosystem health, and producing millions of new jobs as industries come on-line to produce energy efficient products and processes.

With the restructuring process completed, hundreds of billions of dollars now earmarked for harmful subsidies could be shifted to addressing other urgent social and environmental needs.

A systematic transfer of these sustainable technologies to developing regions - along with the aid dollars to develop supporting infrastructure - would stimulate employment and economic growth in both industrialized and developing nations. That growth would also help address issues of inequity, poverty, and environmental destruction, which would, in turn, help lower fertility in developing regions.

Building Sustainable Economies and Communities

To achieve truly sustainable economies and communities, we must stabilize population at a level the resource base can safely support. The means to do this are quite clear - investment in reproductive and community health care, education, social and gender equality, and sustainable economic development. The primary economic indicators we use to measure performance, however, disregard those considerations entirely. So an important starting point for making the shift to sustainability is revising the indicators we use to determine "growth" and "progress."

Developing A New Score Card

The conventional method of measuring economic growth is Gross Domestic Product, or GDP. (Formerly GNP, or Gross National Product.) Unfortunately, GDP is only a measure of economic activity - not an indicator of whether the underlying transactions are positive or negative for human well-being.

GDP considers all economic activity positive. Oil spills such as the *Exxon Valdez* disaster, for example, boost GDP because the resulting cleanup costs billions. Air pollution that causes tens of thousands of deaths and tens of billions of dollars in medical costs each year in the United States is also positive when rated by GDP. Likewise, deforestation, strip mining and overfishing are counted as positive indicators, because they generate increases in GDP.

These economic indicators drive national policy for most nations. If GDP is up, governments tend to promote more of the same. If GDP slips, they often resort to stimulus packages - tax breaks, interest rate cuts, or subsidies - to revive it, while ignoring the environmental and social costs of those policies. But if our indicators of economic progress are inadequate or obsolete, then those policies cannot succeed, because they do not target the real problems. In light of increasing GDP and declining social health in much of the world, it seems clear that we need new indicators.

One possible measure of economic and social well-being is the Genuine Progress Indicator, or GPI, developed by the non-profit research organization, Redefining Progress. The GPI measures overall economic activity, but deducts for resource depletion and declines in social health. It adds for housework, child-rearing and volunteer work, for example, but deducts for loss of leisure time, family breakdown and pollution. By this reckoning, genuine progress in the United States has declined by 45 percent since 1950, even though GDP doubled in the same period.

The Index of Social Health, developed by the Fordham Institute for Innovation in Social Policy, is another potential measure of human well-being. Although it does not account for environmental impacts, it does consider 16 social indicators, including infant mortality, child abuse, poverty among children and the elderly, drug abuse, health insurance coverage, unemployment, average weekly earnings, and the gap between rich and poor. Since the Index was created in 1970, social health in the US has declined by over 40 percent.

The International Human Suffering Index, or HSI, can also be used to chart real growth in human well-being. Developed by Population Action International, this measures life expectancy, daily calorie supply, clean drinking water, infant immunization, secondary school enrollment, GDP per capita, rate of inflation, communications technology, political freedom and civil rights. There is a very strong correlation between high levels of human suffering and higher fertility, so a drop in the HSI would be a positive indicator of both an improvement in human condition, and a trend toward lower fertility. Developing policies specifically targeting those indicators could bring this about.

Its all about choices. When we focus our efforts and expenditures on preparing for conflict, we are often unable to address the very things that cause conflict. Investing in education, human rights, social health, and sustainable livelihoods, can help relieve the conditions that underlie social disintegration and conflict. Photo of Bolivian girl by J. Maillard, courtesy of ILO

No one indicator is likely to meet the needs of policymakers, but a balanced system for measuring true progress could be developed. On a structural level, indicators would include ecosystem health, equity within and between nations, social spending to improve human well-being, income-earning opportunities, access to productive assets and credit, good governance, and community action. Indicators of progress on an individual or family level would include nutrition, health, education, gender equity, human rights, and economic security.

Recognition that a healthy economy cannot occur without healthy families, communities and ecosystems is fundamental to improving the human condition. Developing and applying accurate tools to assess that health is an immediate priority.

Rethinking Priorities

Shifting resources away from traditional expenditures and subsidies and toward sustainable development is a vital component of solving economic and social ills. Despite a growing awareness of the dangers of environmental degradation and the resulting political, economic and social disruptions, the spending patterns of the US and much of the rest of the world are still focused on old threats. World military spending still hovers around 800 billion dollars annually, while environmental spending lags far behind.

Military spending is not the only thing that diverts money from programs to create a sustainable world. While hundreds of millions of people around the world are hungry, Americans - one-third of whom are significantly overweight - spend some $30 billion annually on diet programs.

While some 1.3 billion people suffer in absolute poverty, we in the US spend nearly $19 billion annually on toys. That averages out to $350 per child - equal to, or greater than the annual income of one-fifth of the world's people. We also spend some $500 billion each year on gambling. Just one small portion of that - the $34 billion annual expenditure on lotteries - is twice what the United Nations estimates is necessary to provide reproductive health care globally.

This is not to imply that we shouldn't ensure national security, try to maintain a healthy weight or give toys to our children. However, it does illustrate some of the choices we make about where we do, or don't, allocate our resources. Philosopher Friedrich Nietzsche once said that decision is negation - that once we choose to do any given thing, we are, in effect, choosing not to do other things. In this case, when we choose to spend our limited resources on guns, games, or gambling, it means we cannot invest those resources in education, health care or environmental protection.

Vietnamese women transporting tree seedlings in a small holders nursery. Integrated development can address a variety of issues in a single venture. Projects like these improve soil fertility, control water

Investing in People

It is clear that the issues of stabilizing population, protecting the environment, and improving human quality of life are inextricably linked. We know that poverty is both a cause and result of environmental degradation, and that fertility is linked to poverty. And we know that reproductive and community health care, education, social and gender equity, and sustainable livelihoods are the fundamental pieces needed to address these issues. The challenge is to do so in a holistic, culturally appropriate manner.

Creating the infrastructure to deliver reproductive and community health care services is an obvious starting point. Allowing people to safely and reliably choose the number and spacing of their children would decrease population growth significantly, and save millions of lives. Access to community health care can decrease infant and child mortality (both key to lowering fertility), increase longevity, and allow people to live more productive and fulfilling lives.

Health care services in the developing world needn't follow expensive, Western models. (Those would be inappropriate in many cases.) Basic clinics that deliver "low tech" services such as family planning materials and education, vaccinations, prenatal care, and preventive and primary care could be established with far fewer resources. Delivery of local services - in accordance with the wishes of the local community members and leaders - could be provided by trained local people, with access to physicians and more intensive care on a regional level. Expanded services could be provided gradually, as the community develops and is willing to accept them.

Access to education is equally as important as health care, because of the strong correlation between higher levels of education, greater economic opportunity, and lower fertility. Again, creating the infrastructure to provide universal primary education need not be heavily resource-intensive. Local schools, constructed of locally-produced materials, might even share a building with the clinic. A regional facility could be established to train teachers. As infrastructure is developed, secondary - and ultimately post-secondary - programs could be added.

Delivering educational services would require sensitivity to local culture and concerns. This might also require incentives for parents to send their children - especially daughters - to school. Since children are likely to be an economic asset to poorer families, they are often kept out of school to work. Girls, in particular, are often kept home to do housework, or care for younger siblings.

One incentive for families to send their children to school would be to provide meals for the students. This would relieve the household of the burden of providing food, and help compensate for the loss of the children's labor. Integrated programs that multiply efforts - like introduction of school gardens to provide much of the food for student meals - would be particularly effective. In some situations, it might even be necessary to pay parents a stipend to keep their children in school.

The empowerment of women and the improvement of their social, economic, political and health status is essential to stabilizing population, sustainable development, and environmental protection. In most of the world, women receive less pay relative to men for comparable work and similar education levels. In many places, women's work is simply not counted, even though families and communities are totally dependent upon it.

The empowerment and autonomy of women is a highly complex issue, and solutions will vary with cultural contexts. But one of the primary components is access to education. Women traditionally receive less education than men in most of the world, and two-thirds of the illiterate people in the world are women. Creating incentives for female education as noted above is a key starting point.

Other components include creating mechanisms for women to fully participate in, and be represented at all levels of the political process (as well as in society at large), and eliminating discriminatory practices in employment, land ownership, and access to credit. It is also important to create or strengthen national and community-based groups that foster awareness of women's legal rights. Moreover, education of men as partners in family and household responsibilities must be included.

Along with land reform, human rights and social and gender justice, access to credit is a vital piece of eliminating poverty, stabilizing population, and protecting the environment. Traditional lending models rely on large loans to "creditworthy" organizations and individuals. Lenders have generally viewed small loans as too costly to service, and borrowers without collateral as too risky. The result has been an inability of the poorest members of society to obtain credit.

The "Grameen" micro-lending model changes that. Invented in 1976 by Bangladeshi economist Muhammad Yunus, Grameen banking loans small amounts (often just US $20) to the poorest members of society to start businesses. The process includes education about business and credit basics (as well as about basic health and family planning) and loans are mutually managed and guaranteed by groups of women called "lending circles." The Grameen Bank's borrowing pool is 94% women, and its repayment rate is over 98 percent - far better than conventional loans to "creditworthy" borrowers.

Yunis began the Grameen Bank with under $US 50, which he loaned to some 20 families in rural Bangladesh. (His first loans averaged 62 cents.) The bank now operates in over half the villages in the nation, and loans over $400 million annually. The Grameen model has been emulated, adapted, and transferred to 43 nations to date, and now has some 8 million borrowers. Microcredit has also emerged in some industrialized nations, including the United States. Loan amounts are larger there - perhaps $500 to $1,000 - in amounts sufficient to enable people to start small businesses by financing items like gardening tools or hair styling equipment.

Along with micro-lending, microenterprise also holds great promise in both developing and industrialized regions. Organizations such as the Heifer Project International (HPI) and World Neighbors use "participatory development" models to fight hunger and poverty. HPI provides farm animals to families (along with training in their care, group skills, and basic management techniques) to raise for food and income. Recipients also agree to "pass on the gift," and give one or more of their animal's offspring to another family in need.

Depending on local needs, microenterprise organizations may facilitate development of community wells or water systems, help create community banks, or provide simple tools such as hoes, hammers, or machetes for farming or construction work through a "tool bank." Other possibilities include financing local cooperative enterprises for agriculture or light manufacturing. The most successful microenterprise models are those that seek to integrate sustainable economic development with programs to improve reproductive and community health care, education, and gender equity.

Responding to Migration and Urbanization

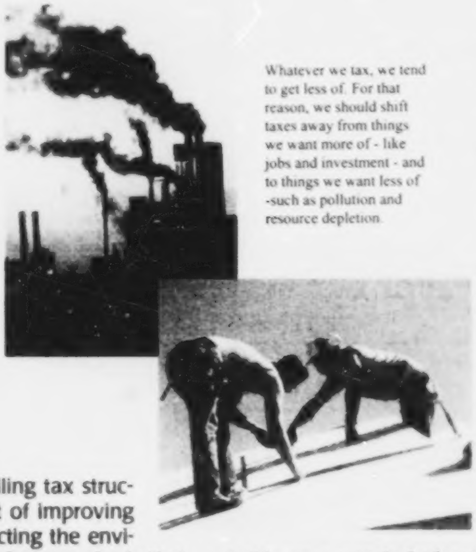
The world is steadily becoming more urban. Rapid urbanization is associated with numerous problems, including poverty, pollution, crime, homelessness, unemployment, and disease transmission. Rapid growth and deteriorating urban health are also associated with civil unrest and political instability.

Some of this urbanization is a result of economic development, but it is also a response to rural poverty and scarcity. "Push" factors that drive rural people to cities include shortages of farmland and agricultural jobs due to population growth, environmental stress, and social or political conflict. "Pull" factors that attract people to cities include hopes of employment, education, or social services.

A two-track approach is needed to combat the negative impacts of rural-urban migration and rapid urbanization. The first, obviously, is working to stabilize population. This would help address scarcity in rural settings and slow the migration of people to cities, because fewer people would ultimately depend on essential resources. Slowing population growth in cities would also buy time for local governments to respond to urban needs by investing in social infrastructure, such as schools, housing, and sanitation.

The second track is integrated development using the indicators listed earlier - ecosystem and community health, nutrition, education, gender equity, civil rights, and economic security - to monitor success. This approach requires that solutions normally applied in isolation from each other and imposed from outside be carried out as part of a holistic effort, designed by local people to meet local needs. Outside funding and facilitation will be necessary in many cases, but community-based, culturally appropriate programs have proven highly successful.

Integrated sustainable development would include comprehensive efforts in almost all sectors - health care, family planning, child development, agriculture, environment, nutrition, education, and income generation. Components could be as simple as an inexpensive machine to make mud bricks for construction, tube wells and solar-powered pumps, training local health workers to provide basic care, introducing drought-resistant crops, providing a small loan for a sewing machine and cloth to start a family textile business, or creating a regional school to train teachers.



Whatever we tax, we tend to get less of. For that reason, we should shift taxes away from things we want more of - like jobs and investment - and to things we want less of -such as pollution and resource depletion.

Rewriting the Tax Code

A major overhaul of prevailing tax structures is an essential component of improving the human condition and protecting the environment. A fundamental tenet of economics is that when something is taxed, less of it tends to be produced. Taxes, therefore, should be shifted away from things we want more of - such as investment and employment - and levied on things we don't want, like resource depletion, ecosystem degradation, and pollution.

A rough outline for determining the validity of any tax structure should be as follows: Does the proposed tax support policy goals by encouraging positive outcomes and discouraging negative impacts? Does it increase economic equity and can it be applied fairly, based on ability to pay? Does it support resource conservation and discourage negative environmental impacts? Can it be fairly, efficiently and affordably enforced?

Most current revenue-generating structures rely on personal and corporate income taxes, and sales and property taxes. (Along with taxes on trade, these account for 90 percent of global tax revenues.) Unfortunately, most of those taxes are either disincentives, or unequally applied across socio-economic lines. Income and payroll taxes, for example, artificially inflate labor costs and discourage employment. Taxes on capital gains and business income discourage investment. Corporate income taxes promote an exemption and loophole system that corrupts politics and is a major source of corporate subsidies and waste.

Sales taxes fall disproportionately on lower-income people, and often fail to tax many of the products and processes that have the greatest environmental impacts, such as electricity, water, most fossil fuels, and pesticides. Property taxes are a mixed bag. Taxes on land can help concentrate development, but taxes on structures tend to encourage sprawl. Shifting a greater share of the tax base to land, rather than structures, could concentrate development, minimize infrastructure costs, and preserve open space. Adding tax deductions for conservation easements could preserve agriculture and timber resource lands, as well as aquifer recharge areas and important habitat.

A comprehensive process of tax reform would - over a period of years, so business and consumers could adapt - shift taxes from work, investment, and commerce to natural resources and environmental impacts. This would ultimately reduce the need for environmental regulation, because prices would reflect environmental and social costs, and business would be focused much more on solving environmental and social problems than on processes and products that create them.

One of the key elements would be a carbon tax, to lower consumption and reduce atmospheric pollution. Such a tax would be phased in - perhaps over a 20 year period - so inefficient automobiles and manufacturing processes could be gradually replaced or upgraded. At the same time, income taxes would be lowered to offset the impact on consumers. The loss of jobs in traditional energy industries such as coal and oil would be offset by new jobs in renewable energy products and processes.

Taxes on pesticides, fertilizers, and other chemicals used in agriculture and industry would reduce runoff and pollution, and improve water quality for household use, recreation, and wildlife. Food prices would increase slightly, but the cost of providing clean water would decline, as would health care costs. A system of taxes and tradable permits on the discharge of pollution - with higher fees for more harmful substances - would be beneficial in improving air and water quality, with resulting improvements in human and ecosystem health.

Resource consumption taxes on extractive industries such as logging, mining, and energy would reduce both environmental damage and consumption. This is especially important in light of the fact that those industries do a disproportionate share of environmental damage, and that they are often conducted on public lands, with no more than token fees or royalties. Resource consumption taxes would promote greater use of existing options such as re-use and recycling, and foster the development of new technologies, products, and processes through market forces.

No package of tax reform and environmental protection would be complete without addressing transportation, since vehicles account for roughly one-fifth of global carbon dioxide emissions, and as much as half the air pollution in many metropolitan areas. A carbon tax would certainly impact vehicle use, but other shifts could be incorporated as well, such as road taxes, and parking and toll hikes.

These would offer incentives for people to use vehicles less, and generate income to pursue more comprehensive solutions. In the long-term, patterns of development would include both efficient public transportation and compact neighborhood planning, so people would not need to spend so much time in vehicles.

Properly designed and implemented, a comprehensive tax shift based on the parameters outlined above could increase employment, protect the environment, and stimulate the economy. Some of the revenues generated from tax shifts could also be invested in new, environmentally-friendly technologies and processes, or support "start-up" subsidies for sustainable industries.

The Bottom Line

We can stabilize world population at a sustainable level, protect and enhance the environment, and balance out the inequalities between nations, individuals and genders. We have the knowledge, the technology and the capital available to do so. What we lack at this point is a shared vision of the world we would like our children and grandchildren to grow up in, and the political will to implement it.

Helping to create that vision - and acting out of that vision to support social justice and sustainability - provides a framework into which all these solutions can fit.

Working together, we can create a positive future for all the world's children.

Guide to Population Issues for Students and Teachers

Curriculum Guide

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Section 1: How to Use the Curriculum Guide

Using this guide...for tomorrow's class

Once you, as a teacher, buy into the idea that population is at the center of everything that happens in our world today, it's natural to want to share that with your students. The problem is: Where do you start?

The Affective Domain Approach

Explore the activities and hands-on activities. You've worked with kids long enough to know how they feel about a topic, issue, or other educational objective is often the glue that makes it stick.

Plant those feelings. These exercises have been used in classrooms around the US and the world to help kids understand the issues underlying population problems.

Once you've gotten on the table or floor with the students for "When the Chips Are Down," explored what to do with a too-full boat in "Lifeboat Ethics," or gotten the class all wet with "Carrying Capacity," you'll have created an experience - and memory - which sticks.

The Concept Approach

Often called "pre-teaching," sometime before you dig deep into population, you may want to review these keys concepts (explained in the introduction of the Guide to Population Issues), which can also be reinforced with the activities:

- The interconnectedness of human numbers and lifestyles and the critical environmental, economic, and social issues we face
- Environmental or ecological "footprints"
- Carrying capacity - how many people can the Earth support?
- Population pressures often lead to scarcity, poverty, and conflict
- The belief - essential to impart when discussing a lot of dark things - that there are solutions in this. Every step, big or small, makes a difference.

The Issues Guide

The Guide itself can be central to a well-rounded discussion and understanding of population issues. Facing the Future offers two versions of the guide: a version written for most high school and college students, usable in Advanced Placement classes as well; and a version we call the "middle school" version, which is generally written so that most middle-school aged readers can handle the reading level, with guidance.

Nowhere on the middle school version is it labeled as such; you may find this version useful in a high school class if time is limited or if the class's reading levels make it a good idea.

Besides the hard copy versions, the complete text of these versions is available online at http://www.popinfo.org (middle school version).

Great! What's next?

The next thing to decide is...Where do you want to start?

On the next page is a suggested scope-and-sequence for three teaching scenarios: a one day review, a one week population unit, and the outline of a nine-week unit (yes, some people actually talk about it that much!) which allows for an in-depth exploration of the issues and also meets many district's global issues requirements.

These, of course, are suggestions; use the parts of this Curriculum Guide which fit your needs and your students' level of interest and involvement.

One Day Lesson Plan

Got only a day for dealing with population? Maybe it's an Earth Day lesson, or related to a special event like the Day of Six Billion. Consider these options, each of which fit neatly into a 50 minute class period:

- Read the Introduction ("Who Really Cares About Population, Anyway?") from the Students' Guide to Population Issues (feel free to make classroom copies for everyone!). Then discuss students' reactions to the Introduction, with emphasis on the interconnectedness of the issues and problems facing the world, caused by population.

  Then, if there's time (especially if you have a longer period), get the class to participate in the activity called "What's Your Favorite Meal?" located later in this Guide. Many teachers tell us this is one of their favorite lessons, partly because it's so easy to prepare. All you need is some butcher paper and a few marker pens. Or you could...

- Show Zero Population Growth's introductory video entitled "World Population" and discuss it. It comes with a 12-page discussion guide; you can order your video from ZPG's website - http://www.zpg.org or by calling 800-767-1956.

  You can also use the discussion questions in this Guide, located in the "Introduction" section in the curriculum materials.

  This is especially effective if your class does not contain strong readers. Or....

- Do the "When The Chips Are Down" activity (located later in this Guide), then discuss the kinds of problems that come up in the activity. See what conclusions students arrive at regarding how human numbers and lifestyles impact environmental, social, and security problems in the scenario, as well as how they relate to the real world.

  Regardless of what you choose to do, if the students come away with a sense that problems - and solutions - are all connected to each other, then you've succeeded.

One Week Lesson Plan

With a week to study population, you can get even more done.

- Day One: Start with Population Jeopardy (this activity, with sample questions, is detailed in the Activities section of this curriculum guide.) This will establish a sense of how much students know, and don't know, about population. Then show the ZPG video mentioned above.

- Days Two and Three: Then, consider doing the other two of the "one-day" lessons listed above, in the order given. You'll be surprised how the discussion begins to build momentum as the students do the activities and begin to "feel" the choices involved with problem-solving, as well as thinking about them.

- Day Four: Spend the day on Carrying Capacity. Begin by reading the section "How Many People Can The Earth Support?" in the Issues Guide.

  Then, do the "Carrying Capacity" activity. Besides reinforcing the points made by the "Chips" activity, this classroom illustration repeats the important theme that the Earth's carrying capacity is limited.

- Day Five: Revisit the solutions section of the "Introduction" which you read the second day. Then use the discussion questions in the "Solutions" part of the Curriculum Guide as part of your concluding activity for the week.

  Whether you integrate the questions with a classroom discussion, writing assignment, or group presentations, it's important to leave the issue with a sense that things can be done to make things better.

Nine Week Lesson Plan

With an academic quarter, in-depth study of the issue is possible. You'll find there is far more than any class could possibly use in this Guide, but here is a suggested framework:

- Week One: Do the week suggested above as an introduction to population issues.

- Week Two: Read and discuss "A Brief History of Population" in the Students' Guide to Population, and follow up with the "In The News" activity. Look over the suggested activities, discussion questions, research assignments (our favorite is the one about choosing an earlier city-state to study), and essay questions for this part of the guide.

- Week Three: Read and discuss "Tracking The Trends" in the Students' Guide to Population, and follow up with the "Hill of Beans" and "Planet Amoebae" activities. Look over the suggested activities (the graphing and mapping ones are especially effective), discussion questions, research assignments, and essay questions for this part of the guide.

- Week Four: Read and discuss "Population and the Environment" in the Students' Guide to Population, and follow up with one or more of the 32 activities listed in the first part of the Activities section, especially 6, 9, 14, and 23-25. Also, check out the Research Assignment called "Name Your Favorite Creature." These should help reinforce the point that the environment is not just something "out there," but a necessary part of every human's survival and pursuit of a fulfilling life.

- Week Five: Read and discuss "Economic and Social Impacts of Population Growth" in the Students' Guide to Population, and follow up with one or more of the activities listed in the first part of the Activities section, especially 17, 22, 26, and 32.

- Week Six: Read and discuss "Population and Religion" in the Students' Guide to Population. Then, depending on your school setting, decide what to do with it. We suggest research assignments which compare cultural/religious values with demographic and economic realities. Explore the theme that religious organizations can play a positive role in understanding and addressing population in a humane and compassionate way.

  Read and discuss "Does the US Have A Population Problem?" in the Students' Guide to Population. Reviewing the concept of environmental footprint here is critical, and can be reinforced with activities 8, 9, 10, and 11, as well as "What's Your Favorite Meal?" and its corollary activities "How Did You Get Here?"/ "What's In Your House?" and "What Are You Wearing?"

- Week Seven: Use "Solutions" in the Students' Guide to Population as the beginning point of discussion about beginning to change things in the world. Activities 27, 28, and 29, and the hands-on illustration "Hondurica" give students a chance to begin to bring their ideas together, and to plan what to do. See also the discussion questions and research assignments in the "Solutions" section of this guide.

- Week Eight: Explore the ethical dilemmas posed by certain approaches to population issues. Do the "Lifeboat" activity under the Ethical Dilemmas section, followed by the "Tragedy in the Commons." Activities 30, and 31 offer additional angles on ethical conundrums, including some of the issues involved with immigration.

- Week Nine: Concluding activity (#33, which involves developing your vision of the future.). Review the Final Projects under the Activities section, as well as the writing assignments suggested in the Curriculum Guide.

Overview for Teachers

The following pages contain curriculum materials to be used in guiding students through Facing the Future: People and the Planet - A Guide to Population Issues for Students and Teachers.

These materials are divided into distinct sections that coincide with the major topic sections of the Guide, plus a "Population Ethics" section to stimulate lively debate, an activities and hands-on section, and suggestions for final projects to assess the level of understanding of the students.

Most sections of this guide offer two sets of problems: Discussion Questions and Research Assignments. There is also a special section with a Activities and Hands-on Illustrations.

Discussion Questions include simple recall questions, as well as more thought-provoking questions to help students relate their personal situations and lives to the main ideas presented in the text. These questions can be used without preparing materials ahead of time.

Research Assignments require independent study. It is recommended that students work on research assignments before reading Facing the Future materials. Students may be assigned a particular set of questions individually, or work in cooperative teams to collect data, prepare and present the information to the rest of the class. Each presentation may be made after reading the appropriate section of the book.

Activities and Hands-on Illustrations require some planning ahead, as materials and resources may be needed. They are designed to further help students internalize the information from the book and see the relevance to their own situations. These may also be used as stand-alone lesson plans.

Several of these Activities and Research Assignments rely on data from the Population Reference Bureau's World Population Data Sheet. A copy of the most current Data Sheet is included with handouts in all Facing the Future teacher trainings and workshops. Additional copies are available as part of a curriculum package from Facing the Future, or from PRB at (202) 483-1100 or through their web site: http://www.prb.org

Numerous population and environment resources are listed on the inside back cover of the Issues Guide. Other potential resources include: local, regional, county and state government offices, local Chambers of Commerce, agricultural colleges, local newspapers, electronic encyclopedia, library resource materials, "old timers" in your community, land management offices, insurance companies, farmers organizations, community museums and historical societies, and county extension agencies.

The Internet is another major resource. The Facing the Future Home Page offers a regularly updated and expanded version of both the Guide to Population Issues for Students and Teachers, and this Curriculum Guide as well as links to numerous other sites.

Visit our page and share your comments about our materials at www.facingthefuture.org and review instructional materials at www.popinfo.org.

A Note About Standards

Facing the Future curriculum materials are designed to conform to Goals 2000 standards, as well as to those of the National Council for the Social Studies (NCSS), and the National Council for Geographic Education (NCGE). For example:

Goals 2000 Geography standards recommend that students "...understand the characteristics, distribution, and migration of human populations on Earth's surface," as well as "...understand how human actions modify the environment." Students must also recognize "...how physical systems affect human systems" and "...the changes that occur in the meaning, use, distribution, and importance of resources."

Goals 2000 Science standards recommend that students understand that, "populations grow or decline through the combined effects of births, deaths, and in countries through emigration and immigration," as well as developing the concept of interdependence among populations, resources, and environments. These standards also call for the study of human populations within the context of populations of other organisms in the ecosystems.

Goals 2000 History and Civics standards call for students to understand how population growth and changes in population composition have shaped US. society and continue to affect the social setting in which policies are created. Standards for the study of world history call for students to understand "...how population explosion and environmental change have altered conditions of life around the world" in this century.

Facing the Future materials specifically conform to NCSS standards I (Culture), II (Time, Continuity and Change), III (People, Places and Environments, V (Individuals, Groups and Institutions), VII (Production, Distribution and Consumption), and IX (Global Connections.

Facing the Future materials specifically conform to NCGE standards 4 (Physical and Human Characteristics of Places), 9 (Characteristics, Distribution, and Migration of Human Population on Earth's Surface), 10 (Characteristics, Distribution and Complexity of Earth's Cultural Mosaics), 12 (Processes, Patterns and Functions of Human Settlement), 13 (How the Forces of Cooperation and Conflict Among People Influence the Division and Control of Earth's Surface), 14 (How Human Actions Modify the Environment), 15 (How Physical Systems Affect Human Systems), and 16 (The Changes That Occur in the Meaning, Use, Distribution, and Importance of Resources.)

Section 2. Goals and Objectives

Goals and Objectives

The major goal of this curriculum is to educate young people about the nature and impacts of world population growth, and to help them take responsibility for, and feel empowered to help solve population-related problems. This includes these specific goals:

1. Students will understand the interconnectedness of population growth and key issues confronting the world today.
2. Students will understand patterns of population growth and change within their own community, and identify the attitudes and policies that affect population growth within that community.
3. Students will understand historical population facts in a time sequence and alternative future scenarios.
4. Students will become aware of their personal responsibility for and power to help solve population and related global issues.
5. Students will develop ways and means of communicating the message to their community that sustainable human numbers and life-styles are essential to human and ecological well-being.

Section 3. Curriculum Guide by Issue

Introduction: Who Cares About Population, Anyway?

Discussion Questions

How do human numbers impact your life? What are some of the positive ways in which they do so? (For example: economies of scale make manufactured goods or infrastructure more affordable.) What are some of the negative ways? (For example: greater demand raises prices for some items, or increases competition for jobs.)

What are four situations in which you feel "crowded?" (For example: in an elevator, at a party, on a boat, bus or airplane.) What is your usual reaction to this feeling? How would you feel if this situation were permanent?

A Brief History of World Population

Discussion Questions

Why was population relatively stable for most of human history? When did that begin to change significantly? Why?

What was the estimated population of the world at the beginning of the Age of Agriculture? How does that compare to your city, state and nation today?

Why did birth rates apparently increase when people took up a settled existence? What was the economic advantage of that shift?

How did population growth contribute to the rise of cultures?

How did population growth contribute to the fall of cultures?

Explain the concept of "ecological suicide." Cite some historical examples of this situation.

Name three early scientific or technological advances that stimulated food production and economic development.

Name three significant setbacks to population growth.

Explain the correlation of population growth and the age of European exploration and colonization.

Identify three factors leading to rapid population growth in the last 200 years.

Imagine and discuss how your life would be different without the listed medical advances. How many of the people in your life might not be alive without those advances? How have those advances caused demographic change in different regions?

Research Assignments

Choose an earlier city state, civilization or empire to study. Determine what factors and resources led to its founding, success, and ultimately to its decline. If the cause of its decline was conquest by another civilization, determine what factors drove that conflict.

Research local census data. Determine how the populations of your community and your state have changed over the last 100 years. Graph the population change in your community and in your state to illustrate increase or decrease. Highlight significant shifts, and determine the reasons for those shifts. How did the local economy, ecology and society change in the process?

Design a chart, graph or graphic that illustrates the statistics about world population growth given in this section. Create a similar graph for your country since its founding.

Construct a time line of technological developments in the fields of transportation, communication, food production, manufacturing and medicine. Compare the availability of these advancements in wealthy countries to their availability in developing countries. Discuss how these advances have affected population growth.

Determine when common immunizations were started. Research the work of Pasteur, Lister and Koch, and describe their influence on population growth. Name several other technologies or processes that significantly affected population growth.

Research the obituaries in old and new newspapers. List the causes of death, and identify the ages of the people who died. Chart or graph this data to compare the causes and ages of death in historical and modern times.

How Many People Can the Earth Support

Discussion Questions

Define the concept of "carrying capacity."

Is there a difference between biophysical carrying capacity and social carrying capacity? Explain your answer.

List several possible symptoms or impacts that might indicate reaching or exceeding biophysical carrying capacity.

List several possible symptoms or impacts that might indicate reaching or exceeding social carrying capacity.

What sort of institutions are necessary for societies to survive? How might those institutions be affected if social carrying capacity were reached? How might those institutions be affected if biophysical carrying capacity were reached?

What are the basic needs of all human beings? What resources are necessary to provide for those needs? What additional things do you consider necessary in order to live a comfortable and fulfilling lifestyle? What additional resources and processes are necessary to provide for those needs?

What environmental elements - such as wildlife or wilderness - do you consider necessary to support a fulfilling lifestyle?

Describe five environmental elements or resources necessary to living the fulfilling lifestyle you have described. List five environmental impacts of living that fulfilling lifestyle. Are these environmental impacts and the environmental elements or resources you listed in conflict? What is the result of that conflict? How might that conflict be resolved?

Does lowering our impacts necessarily mean reducing our quality of life? How might you maintain a comfortable and fulfilling lifestyle, but lower the associated environmental impacts?

What would be the consequences of six billion people sharing your comfortable and fulfilling lifestyle? How would that impact you economically, environmentally, socially and politically? How might that impact your access to education, employment and recreation?

What would be the consequences of 12 billion people sharing your comfortable and fulfilling lifestyle? Do you believe that would be sustainable? How might your life change in response?

How could a comfortable and fulfilling lifestyle be provided for all the world's people? If this does not seem possible, what are some of the potential consequences of continued and increasing inequity between individuals and nations? Do you see examples of that occurring today? If so, what consequences are evident, and where? What underlies them?

Research Assignments

Study and explain the population policies of developing nations such as China, India and Indonesia. Determine why these nations have implemented such policies.

Study and explain the population policies of industrialized nations such as Germany, France and Japan. Determine why these nations have implemented such policies.

Research and draw up a list of human needs in both agrarian and industrialized societies. Determine the resources required to support each lifestyle, and the impacts of supporting each lifestyle. Project human needs as each society experiences population growth. Forecast how the agrarian society will likely evolve and develop, and what impacts will result.

Study and report on the works of English economist and sociologist Thomas Malthus (1766-1834) who argued in An Essay on the Principle of Population that poverty and distress are unavoidable because population increases faster than the means of subsistence. Explain whether you agree or disagree with Malthus. Why? What evidence supports your view?

Research and report on situations in which carrying capacity was exceeded by various human cultures. (Mesopotamia, North Africa, the Maya, Easter Island, etc.) What happened? Are there similar situations occurring today? Where and why?

Tracking the Trends: A Look at Key Indicators

Discussion Questions

By about how many people is world population increasing each year? Where is most of this growth occurring?

Why is world population continuing to increase rapidly, despite declines in global birth rates?

What is "population momentum."

Describe the general pattern of population growth today. Where is the majority of that growth occurring? Why?

At current growth rates (constant fertility scenario) when will world population double?

Under the constant fertility scenario, what will world population be in 2050?

Explain the difference between "renewable" and non-renewable" resources.

Why is per capita grain availability decreasing, despite production increases? Why is grain production such an important indicator?

Define the "Green Revolution." How was it achieved? What some of were the major benefits of the Green Revolution? What were some of the negative impacts?

Explain how, as nations develop, their diets and consumption patterns change. What are some of the resources necessary to support those changes? What are some of the potential impacts of these changes, both positive and negative?

Describe your favorite meal. What technologies, natural resources and energy expenditures are necessary to provide it? How many can you think of? What are the negative environmental impacts associated with providing that meal? (Also see the collaborative Classroom Illustration, "What's Your Favorite Meal?")

In the past 50 years, how much of the earth's land area has suffered moderate to extreme soil degradation from human activities? Based on population projections and corresponding resource requirements, do you believe this trend is likely to continue? What are some potential impacts if this trend continues? How might this impact you, your family, and community?

Discuss how climate change, availability of arable land and irrigation water, and production techniques could affect food production.

What are five possible consequences of a significant decline in global food production? Even though the US currently does not face food scarcity, how might the US economy and security be impacted by food scarcity in other regions?

How has food production traditionally been increased? How was production increased during the "Green Revolution?" Do these methods of increasing production appear to be viable options in the future? Why or why not? Name several possible side effects of increasing production in this fashion. In what other, lower-impact ways could food production be increased?

What are some possible consequences of a significant increase in global food production?

How could food production be increased? Name several possible side effects of such an increase.

Explain the hydrologic cycle that provides the Earth's renewable supply of fresh water.

How does per capita water availability today compare to per capita water availability in 1970?

What are some possible consequences of decreased water flows in rivers to natural systems and to people? How could that affect you?

How many countries currently face water shortages to some degree? How many people are likely to face water shortages or scarcities by 2050? What are some possible consequences of decreasing water availability? How might this problem be addressed?

Even though the US as a whole does not face water scarcity in the foreseeable future (although many local communities suffer from both water shortages and water pollution) how might water scarcity in other regions impact the US?

Explain trends in economic equity since 1960. What are some possible environmental, social, and political impacts of these trends?

Explain the two primary types of scarcity. What are some examples of each, and how could each be addressed?

Research Assignments

Select a region of the Earth such as Africa, Asia or North or South America. Using the Population Reference Bureau's World Population Data Sheet, calculate the doubling times for each nation in your region, and create a color-keyed map to display the results. Use red for doubling times under 25 years, purple for 26 - 35 years, orange for 36 - 50 years, pink for 51 - 100 years, and yellow for over 100 years.

Select a region of the Earth such as Africa, Asia or North or South America. Using the Population Reference Bureau's World Population Data Sheet, determine the Total Fertility Rate for each nation in your region, and create a color-keyed map to display the results. Use blue color for TFR's under 2, yellow for 2 - 3 children, pink for 3.1 - 4 children, orange for 4.1 - 5 children, purple for 5.1 - 6 children, and red for over 6 children.

Select a region of the Earth such as Africa, Asia or North or South America. Using the Population Reference Bureau's World Population Data Sheet, determine the Per Capita GNP (Gross National Product) for each nation in your region, and create a color-keyed map to display the results. Use red for incomes under $500, purple for $501 - $1,000, orange for $2,001 - $4,000, pink for $4,001 - $8,000, yellow for $8,001 - $12,000, and blue for over $12,000. Where in your region is the per capita GNP lowest? Where is it highest?

Select a region of the Earth such as Africa, Asia or North or South America. Using the Population Reference Bureau's World Population Data Sheet, determine the Population Density for each nation in your region, and create a color-keyed map to display the results. Use green for densities under 50 people per square mile, blue for 51 - 100, yellow for 101 - 250, pink for 251 - 500, orange for 501 - 1,000, purple for 1,001 - 2,000, and red for over 2,001 people per square mile. What is the least densely populated nation in your region? What is the most densely populated?

When all mapping exercises are complete, asks students to present their findings to the class. Ask all students to look for patterns among the various data sets. Is there a correlation between TFR, income, density and doubling time? If, so, define that correlation. Is there a correlation between these factors and events in those regions, such as hunger, conflict, or disease?

List the resources important to the economy and security of your community. Graph the relative availability of these resources over the past 100 years, both in total quantity and per person. List the benefits and impacts of exploiting those resource on the local culture, economy and environment.

If you live in a farming community, research and list the crops grown in your area. Interview your parents and grandparents about the ways farming has changed in recent times, and write an article outlining those changes. Research and list the forms of efficiencies being used in your area, and the impacts they have had on production, employment and the environment. Determine and graph the percentage of local economic activity and employment represented by farming over the past 50 or 100 years.

Determine the amount of land in your area that was once farm land. Then, determine the amount that is now farmland. Using this information, create a chart or graph to compare the reduction of farm acres with the increase in population.

Perform an exercise similar to the above if you live in a timber community. Determine the type and amount of timber harvested, the products generated and their markets, and the number of people dependent upon the resource. Research and list the forms of efficiencies being used in your area, and the impacts they have had on production, employment and the environment. Determine and graph the percentage of local economic activity and employment represented by the forest products industry over the past 50 or 100 years.

(Note: Each of the above three projects can be assigned on a national scale for students in urban / suburban areas.)

If you live in an urban or suburban area, research and list where your produce comes from, and how it reaches your community. (Visit your local supermarkets. Check the shelves, and talk to department managers.) If much of your food is transported from locations far away, determine what impacts a shortage of fuel (as in the oil embargoes and shortages of the 1970's) would have on food availability and price.

Research your own community, region and state and determine the balance between population, food and water over the last 100 years. Illustrate this balance.

Population and the Environment

Discussion Questions

How long have human beings inflicted significant impacts on local environments? What types of impacts were evident in early times?

Explain the cycle of the rise and fall of civilizations from the beginning of the Age of Agriculture until the Age of European Expansion. What part did environmental degradation play in these cycles?

What is the greatest single cause of deforestation? How does this vary from more to less developed regions?

What benefits do you and your family receive from intact forest systems? What benefits do you and your family receive from the exploitation of forest systems? What steps could you personally take to reduce impacts on forest systems? Why is it important to maintain our forest regions around the world? What is interfering with our need to preserve forest regions?

How many species are estimated to go extinct every year? What is the primary cause of these extinctions? What is the correlation of human population density and natural habitat?

Explain the relationship between increasing population, resource consumption and environmental degradation. Using the formula I = PAT (Environmental Impact = Population, times Affluence or Consumption, times Technology) explain how changes in any of the components change the level of impact, even if the other components remain static. Explain how increases in all of the components multiply impacts. How could appropriate technologies mitigate impacts?

Describe five of the most common environmental impacts created by industrialized regions. How do you and your family benefit from the products and processes which create those impacts? How do you and your family suffer from the impacts of those products and processes? How might each of those impacts be reduced, while retaining the benefits?

Describe five environmental impacts created by expanding populations in developing regions. How do people in those regions benefit from the products and processes which create those impacts? How do they suffer from the impacts? How might each of those impacts be reduced, while retaining the benefits?

List everyday things you use that rely on fossil fuels. How does the use of fossil fuels affect the atmosphere? What can you personally do to decrease fossil fuel use? What kind of national policies might be established to decrease fossil fuel use?

Where does your energy come from? What are the processes and resources necessary to deliver that energy? What are the associated costs and impacts of that energy production? Is your energy subsidized? If so, how and why?

Are renewable energy technologies available in your community? If so, which technologies? How can you support the use of renewable energy technologies?

How will damage to the ozone layer of our atmosphere eventually affect our sources of food? How will it affect human health? How might it affect wildlife?

How does the population growth in a wealthy country affect the living conditions of people in poor countries and cities? What can you do about this situation?

Look at your own community and point out ways it is affected by population change. Ask your parents, grandparents or other long-time residents how your community has changed over the years.

Name three possible causes of future population growth (or decline) in your community. Name three potential impacts of that growth or decline.

What are some possible implications if all the world's nations were to adopt an modern industrialized lifestyle? How would it effect local, regional and our global environment? What pressures might this lifestyle change place on the "have nots" of societies?

Research Assignments

List the three environmental issues you feel are most important. Research and chart the primary causes of each issue. List the various impacts, their extent, and how they impact you, your family and community. Determine what policies are in place that exacerbate each impact, and who benefits from those policies. Determine what policies are in place that mitigate each impact, and who benefits from those policies. Outline new policies to protect both the resources and the communities dependent upon them.

Research global climate changes over the past 100 years. Determine the effects of this change on world weather systems, and the resulting impacts on human communities. List probable future environmental, economic, political and social impacts if these trends continue. Graph changes in global temperatures and CO2 emissions. List the ways in which your personal actions result in CO2 emissions, and outline ways to reduce those emissions.

Examine trends in biodiversity. Choose a particular indicator species of animal, plant or insect and graph its relative increase or decrease. Determine the causes of that increase or decrease, and outline possible solutions. Identify a particular type of habitat and list as many creatures as possible that depend upon it. Is that type of habitat increasing, stable, or decreasing?

Name your favorite wild creature. (This may be a mammal, bird, amphibian or insect.) Explain why you chose this creature. Study its life cycle and habitat. Determine its historic range and numbers compared to its present range and numbers. If the creature's range and numbers have increase or decreased, determine the reasons for that increase or decrease. Outline connections between the status of the selected species and the status of other species in its food chain - both predators and prey. Summarize your results for presentation to the class.

Research city versus rural populations in your area, and the number of acres in farmland and forests. Chart or graph how it has changed. Brainstorm and list possible effects this change is having on the use of resources, food availability, jobs, and poverty.

Research the dominant industries or economic activities in your area. (What generates the most income or greatest number of jobs?) List the benefits of this activity in one column and the negative impacts in another. Analyze the result, and propose policies to balance social, economic and environmental concerns.

Research national, state and local laws relating to economic use of public lands by private companies and individuals. Determine whether these laws balance environmental protection and economic development. If not, outline new laws to create such a balance.

Research city versus rural populations in your area, and the number of acres in farmland. Chart or graph how it has changed. Brainstorm and list possible effects this change is having on the use of resources, food availability, jobs and poverty.

Research and graph population and consumption in your country during this century. Examine long and short-term trends, and discuss their possible causes and implications. Outline the relationship between levels of consumption, economic activity and environmental damage.

Economic and Social Impacts of Population Growth

Discussion Questions

Discuss the concept of percentage versus absolute numbers. Explain how poverty or illiteracy rates could be going down, while the actual numbers of poor or illiterate people in many areas are increasing.

Explain the formula H = R÷P. (Human condition = Resources ÷ Population.) Cite three examples of how the formula might apply to key resources.

Name the top three social issues that concern you. Do you see a correlation between these issues and population growth? If so, explain that correlation. If not, explain what other factors drive these issues.

What is causing people to move from rural areas to cities in many countries? What are some of the side effects of rapid urbanization? How could population growth in cities be reduced? How could rural to urban migration be reduced?

Explain the correlation of population growth and crime rates in many locales.

How is rapid population growth linked to unemployment and underemployment?

While measures of economic activity, such as Gross Domestic Product, have consistently improved, indices such as the "Genuine Progress Indicator" have declined significantly. Explain how this is possible.

Explain how population growth can contribute to increasing poverty.

Explain how poverty can contribute to population growth.

What are some of the social consequences of poverty?

What are some of the environmental consequences of poverty?

Explain how population-induced resource scarcity increases existing social and/or ethnic tension. Cite several examples around the world of political tension and/or conflict exacerbated by scarcity.

How does population growth help drive migration?

How might increasing scarcity affect poorer nations and regions? What are some possible political and security impacts?

Some projections indicate that if present fertility and immigration patterns continue, whites will become a minority in the US around 2050. What stresses is this likely to place on the nation's social fabric if it occurs?

Though China's "One Child" policy is controversial, it seems to be effective in limiting population growth. Should other nations adopt similar policies? What are some of the positive aspects? What are some of the negative aspects?

Many people have historically made their decision to have children based on economic considerations. (Can they afford them? Do they need children to work in the family business or on the farm?) Can we rely on that today, or are government policies needed to control population growth? If government policies are needed, what sort of policies do you believe should be implemented? Should they be voluntary, incentive-based, punitive, or a mixture of all three?

Research Assignments

Identify five resources which may be a source of conflict as they become more scarce. Identify what make those resources valuable, and whether there are alternatives to those resources.

Research and identify five areas of the globe where scarcities of these resources currently exacerbate internal or trans-boundary conflict. What are the nature, duration and intensity of each of those conflicts? Identify the opposing factions, and their situations. How do those conflicts impact you?

Research and identify five areas where resource scarcity may create the potential for such conflicts in the future. What are some of the potential environmental, social and humanitarian impacts of such conflict? How might those conflicts impact you? Suggest humane ways to avert or resolve those conflicts.

Historically, rationing has been used during wartime to conserve scarce resources. Prepare a report about World War II that explores what was rationed, why, and how people responded to that scarcity. Interview your grandparents or other elders in your community about what they experienced in that time.

What resources might it become necessary to ration in the future? How might that impact you? What sort of plan would you devise to allocate resources should such rationing become necessary?

Research and record areas around the world where conflict is occurring. Choose one particular conflict and explore the reasons for that conflict. Who are the combatants? Is there a historical pattern of conflict there? What demographic, economic, environmental, and social conditions exist there? What are the economic, environmental, social, and security impacts of that conflict on the region? What peaceable solutions might be implemented?

Population and Religion

Discussion Questions

Why do many demographers argue that economic and cultural contexts are more likely to dictate family size than religion? Explain the correlation between poverty, low indices of social health, lack of education, and fertility.

Explain why some observers contend there is no Catholic "demographic" problem, but an extremely serious Catholic "political" problem.

Why do the Catholic nations of Italy and Spain have some of the lowest Total Fertility Rates in the world?

How has the Catholic Church influenced family planning policies in various countries?

Explain why the head of the United Nations Population Fund contends that cuts in family planning funds for the developing world by the United States will result in significant increases in child and maternal deaths, and million of abortions.

Is there an official Islamic position on birth control?

Explain why efforts by Islamic organizations to improve social welfare are likely to result in declining birth rates where those services are provided.

Explain the great diversity in fertility rates among various states in India, despite the fact that much of the population shares similar religious beliefs.

In light of the serious environmental, economic and social problems created by population growth, why do some religious leaders oppose efforts to stabilize population? Do you believe this is appropriate? Why?

Some observers suggest that the social and ecological crises we face around the world are fundamentally spiritual in nature, and that religious leaders must take a leading role in creating a just, secure, and sustainable future. Why? Were they to do so, how might the separation of church and state be maintained, and the rights of those who believe differently be protected?

Research Assignments

Choose several cultures from different geographic regions, including Africa, Europe, Asia, and North and South America, and research their customs and beliefs about: religion, children, the place of women in the society, and birth control beliefs and practices. Use this research data to construct charts, graphs and/or posters comparing different cultures. Summarize your results and make a presentation of your findings to the class.

Choose a geographic region such as South America, Western Asia or Eastern Africa from the Population Reference Bureau's World population Data Sheet. Select seven countries within that region and identify the dominant religion or religions practiced within those countries. Then, using the Data Sheet, create a chart or graph comparing the countries in that region by religious practice, Total Fertility Rate, Infant Mortality Rate, Total Life Expectancy, and Per Capita GDP. Analyze the results your research and identify any consistent patterns. If there is a similarity of religious practice, is there a corresponding similarity in fertility, infant mortality, life expectancy and per capita GNP? If there is a diversity of religious practice, is there still a similarity in fertility, infant mortality, life expectancy and per capita GDP? Summarize your results and make a presentation of your findings to the class.

In 1968, Pope Paul VI convened a special commission of 12 Cardinals to advise him about birth control. Their majority advice was that birth control was not sinful, yet the Pope issued his historic encyclical Humana Vitae forbidding its use. Had the Pope ruled otherwise, what effect might his decision have had on the predominately Catholic countries of South America? How does the current Pope feel about this issue today?

Does the U.S Have a Population Problem?

Discussion Questions

What is the current population of the United States. By roughly how many people is the United States growing each year? What are the components of this growth? How does this compare to other industrialized countries?

Explain why, based on per capita environmental impacts, some observers argue that the United States has a serious population problem.

Name three possible causes of future population growth in your community. Name three potential impacts of that growth.

Name three possible causes of future population decline in your community. Name three potential impacts of that decline.

Why is US population policy considered "Pro natal?" Do you believe this is an appropriate policy? Why or why not?

How do American families benefit from these policies? How do American families suffer from these policies?

What new policies might be implemented if the US public were to support sustainable population levels or even "anti-natal" incentives? How? Name five things that could be done to help stabilize US population if the people of this country agreed that was necessary.

How important a factor is immigration in driving US population growth? Do you believe annual immigration levels should be increased, decreased, or remain the same? Why?

Would stabilizing the US population reduce our environmental impacts? Why?

Could we reduce those environmental impacts without stabilizing population? If so, how?

Why would stabilizing US population have a major impact on trends in global resource consumption and environmental damage, despite the fact that the US constitutes less than five percent of global population?

Look at your own community and point out ways it is affected by population change. Ask your parents, grandparents or other long-time residents how your community has changed over the years.

What are some possible implications if the rest of the world adopting an American lifestyle? What pressures might this place on the "have-nots," and on the environment?

Research Assignments

Research and graph US population growth since 1800.

Research and graph immigration into the US since 1800.

Determine from which countries immigrants journeyed to the US in the past, and from which countries they come today. Compare those trends over time. Determine what conditions were in the home countries of those immigrants that drove their migration. Graph the changes in immigration from a particular country over time, and detail the prevailing economic, political and social conditions in that country over the time period corresponding to that migration. What were the "push factors?"

Determine what economic, political and social conditions existed in the US at the time of various immigration flows. What were the "pull factors?"

Research what policies and incentives the US Government offered to immigrants and citizens to settle the Great Plains and the West. What were the social, economic, political and environmental results of those incentives?

Research what incentives your community offers new arrivals today. (Whether they are businesses or individuals, from internal migration or immigration.) What impact do these this have on local infrastructure and services, and the local economy and environment?

Research Federal and state laws relating to economic use of public lands by private companies and individuals. Determine whether these laws balance environmental protection and economic development. If not, outline new laws to create such a balance.

Research city versus rural populations in your area, and the number of acres in farmland. Chart or graph how it has changed. Brainstorm and list possible effects this change is having on the use of resources, food availability, jobs and poverty.

Research and graph US population and consumption during this century. Examine long and short-term trends, and discuss their possible causes and implications. Outline the relationship between levels of consumption and environmental damage.

And Now the Good News: Personal and Global Solutions

Discussion Questions

In your opinion, which causes of population growth do you have control over? How can you exercise that control?

How could you lower your own environmental impacts?

Describe three ways to lower environmental impacts in your own home.

Describe three ways to lower environmental impacts at your school.

Describe three ways to lower environmental impacts in your community.

Could you lower your impacts as above without diminishing your quality of life? How?

What do you believe is the most pressing environmental issue in your community? How might it be resolved? What can you do to help mitigate it?

How could you influence political policies regarding population and environmental issues?

Explain how consumer demand can help promote environmentally friendly industries and products.

Do you think there is a "taboo" about talking about population issues? Why? Describe three ways to increase public awareness of population issues.

Briefly describe the major components necessary to stabilize population on a global scale.

Explain the importance of providing reproductive health services in stabilizing population. By how much might population growth be decreased almost immediately if those services were universally available?

How does empowering women help stabilize population? What are some of the structural and cultural obstacles to empowering women? How might those be overcome in just, humane, and culturally-appropriate ways?

Why is educating girls one of the key pieces in population stabilization? How do education levels correlate to fertility rates? What sort of incentives might be necessary to persuade families to send their daughters to school?

Why would education alone be unlikely to achieve population stabilization?

How is farmland currently threatened by population growth? How might farmland be protected from development to help assure food security in the future?

How would empowering women help increase food security in much of the world? How could this be done on a small scale?

Describe the general trend in fresh water availability. How is most fresh water used? What are some potential environmental, economic, and security impacts of water scarcity?

Explain how children can be an asset to poor people, and why poor people tend to have larger families.

Explain the correlation of high fertility rates to low levels of social welfare. How might that be addressed?

Why is improving community health important to stabilizing population?

What are the primary reasons behind deforestation around the world? What are some potential implications of continuing deforestation? How might these be addressed?

What is the primary reason for species extinction and biodiversity declines? What are some potential implications of declining biodiversity? How might this be addressed?

What is the primary cause of atmospheric pollution? What forms does it take, and how do they impact humans and the natural world? How might pollution be reduced in a deliberate way that balances human, environmental, and economic health.

What is the current measure of economic progress? Why do many observers argue this measure is inadequate? What indicators do you believe should be considered in measuring "progress?"

What types of taxes currently generate the majority of revenue worldwide? How do these taxes impact the environmental, economic and social issues outlined earlier? How could these taxes be shifted to support sustainable goals?

How can you help shape the debate on creating sustainable population and development policies?

How might population changes in your own community, your own country and in the world affect your future? What are some benefits and disadvantages?

Research Assignments

Write a paper in which you define the term, "sustainable development," and discuss its main components. Outline how application of this concept could address three existing economic, environmental or social issues.

Research and report on the incidence of infant and child mortality, life expectancy and education levels in various regions of the world. Correlate these to fertility rates in those regions, and outline solutions to stabilize population in each region. Would those solutions also improve environmental conditions in those regions. Why?

Research and report on sustainable agriculture programs, and their applicability to food production in your community, and in developing regions. Determine what technologies would be necessary to implement sustainable agriculture programs in developing regions, and brainstorm a way to deliver those in a culturally appropriate manner. Would those same techniques be applicable in industrialized regions? If so, are they being implemented in those regions? Why or why not?

Research "urban agriculture" - its current importance and extent, and its potential to increase food security. Outline a program to help supply local food needs through urban agriculture.

Design an affordable, accessible system to deliver medical services in a least-developed country. Bear in mind that it must overcome a lack of infrastructure, capital, and technology.

Design an affordable, accessible education system for a least-developed country. Bear in mind that it must overcome the same obstacles listed above.

Research current data in your country for as many indicators of your "Index of Progress" (as designed above) as possible. Graph those results to model current status of your Index. Do the same for the world as a whole. Report on your findings, and outline sustainable ways to improve the indicators on your Index.

Research debt relief and "debt for nature swaps." Explain how these processes work, and cite examples where they have succeeded. Identify other areas where you believe they could succeed. Outline how that might work, and what it would take to implement such a program. Is there a way you could facilitate it?

Contact an environmental organization working in your area, inquire about their programs. Ask how you as an individual, your family, or your class can contribute to their efforts. Report on this to your family and your class.

Section 4. Population Ethics Issues

The Tragedy of the Commons

Biologist Garrett Hardin used the term "The Tragedy of the Commons" to dramatize the conflicts which can exist between people's short-term and long-term interests. The specific example he uses is that of a community of herdsmen who graze their cattle on a common pasture owned by the village.

It is to the short-term advantage to any individual herdsman to increase the size of his herd, because his production will be greater, and his family will benefit. The costs of his actions - overgrazing and damage to the commons - will be minimal to the individual, because they are born by the community as a whole. Similarly, if other herdsmen increase the size of their herds and any given individual does not, that individual will suffer because the commons will be damaged by overgrazing, but he will have nothing to show for it.

Carried to its conclusion, each individual acting his own best short-term interests, increases the size of his herd. This then leads to the tragedy of the commons —the destruction of the community pasture from overgrazing, the death of all the herdsmen's cattle from starvation, and the economic (and perhaps physical) death of the community.

Name some other ways in which individuals acting in their own best short-term interests may create a tragedy of the commons situation, and damage their own long-term interests.

(One example might be clearcutting a forest for short-term profit, even though the results will be erosion - leading to silting of rivers and loss of salmon runs - loss of wildlife habitat, and loss of recreational opportunities for the larger community. The failure of the forest to regenerate due to soil erosion, may also result in a significant long-term financial loss to forestry interests. Overfishing might be another example. In catching more fish than can be harvested sustainably, fishers may deplete the resource to the point that none of the fishers can survive economically.

A third example might be the US automotive industry's efforts to delay or defeat anti-pollution and fuel efficiency regulations. The manufacturers and shareholders benefit in the short-term because they did not have to invest in new technology, but consumers end up paying for more through increased energy consumption. Citizens around the globe may also be harmed in the long-term, because the additional pollution contributes to smog, acid rain and global warming.)

What do you believe should be the government's role in regulating "commons" situations? Who do you believe should determine allocation of community resources? What sort of process would you design to accomplish this?

Lifeboat Ethics

Hardin also posed the question of "Lifeboat Ethics," using the metaphor of a lifeboat at sea to dramatize the situation of the few prosperous and food-sufficient industrialized countries surrounded by dozens of poor, rapidly-growing and resource-scarce nations. The rich nations are in the partially-filled lifeboat, and the poor are in the water.

Those in the lifeboat face three choices. They can try to pick up all those in the water, which will overload and swamp the lifeboat. They can try to pick up as many as the lifeboat will hold, even though this diminishes their own chances of survival by reducing their margin of safety, and forces them to make the difficult decision of which people to rescue. Or they can fend off those in the water, and row away.

Hardin suggests the last option - rowing away - as the most realistic choice for the industrialized nations. This is harsh, he acknowledges, and may be perceived as unjust. But he suggests that those who disagree with the choice can trade places with those in the water. In real terms, he recommends that the US and other nations cease giving food aid to poor nations, because access to that food simply allows the population to increase further, making the ultimate outcome of starvation and tragedy that much larger in scale, but no less inevitable.

How does Hardin's suggestion compare to existing policies?

What would likely be the short-term and long-term humanitarian costs of such a policy?

What might be the short and long-term national security costs of such a policy?

Is this an "either or" situation? What other potential solutions might solve this problem in a more humane manner?

(As this discussion unfolds, it may be interesting to note which students advocate which positions. If the class splits along gender lines - with the majority of male students arguing for the "rowing away" theory and the majority of female students arguing for a more humane course of action - a discussion of gender roles and perceptions may be an appropriate spin-off.)

Other Ethical Dilemmas

If we don't set our own thresholds, nature provides its own limits. Should we simply allow what Malthus called, "positive checks," such as famine and disease to limit population?

Should aid be provided to poorer nations by wealthier nations? If so, how would you decide which countries receive the aid, and how should it be divided between economic development, food supplements and social welfare programs, including reproductive health care and education?

Should countries that have slow-growing, stable or declining populations undertake programs to increase fertility? Why or why not?

Should countries that have slow-growing, stable or declining populations promote immigration? Why or why not?

Should prosperous and secure nations in the industrialized world accept significant numbers of refugees from areas in the developing world troubled by famine, conflict and political or religious persecution? Why or why not?

Since it takes roughly 6 to 8 pounds of grain to raise a pound of beef, should there be a law limiting consumption of meat so hungry people could have that grain?

If a society agrees that it must limit the number of people who are born, how might this be undertaken? What role should coercive methods such as euthanasia, exile, withholding benefits or sterilization play? What incentive-based methods might be employed, and how would you pay for them?

What do you believe should drive decision-making about population policies - peoples' welfare or the economy? Why?

The Prophet Mohammed says in the Quran (Koran), "The worst problem is to possess plenty of children with inadequate means." Should laws be made to reinforce that idea? Should people with inadequate means be prevented from having children, or limited in the number of children they can have? Should governments make up the difference, to make sure that adequate means are available for all children?

Section 5. Hands-On Illustrations and Activities

Using the Activities

These activities are split into two main groups: The lessons below are general and speak to the general interconnectedness of the population themes; after them come activities which are organized by issue, corresponding to the Population Guide.

Look over the activities and decide how your students will respond - the activities work as both warmup and followup for exploring the issues.

1. One of the best ways to introduce students to population issues is with a quick round of "Population Jeopardy." To establish a baseline of knowledge, ask questions such as, "What is the current population of the world? (Six billion in 1999.) What is the "doubling time" of that population? (49 years.) What are the three most populous countries in the world? (China, India, the United States.) What is the average life expectancy in North America? (77 years.) What is the average life expectancy in Eastern Africa? (44 years.) What is the richest country in term of total Gross Domestic Product? (GDP) (The United States, $7.3 trillion) What is the richest country in terms of per capita GDP? (Switzerland, $43,060.) What is the poorest country in terms of per capita GDP? (Democratic Republic of the Congo, $110.) What is the most densely population country in the world? (Monaco, with 44,000 people per square mile.) What is the least densely population country in the world? (Western Sahara, with 2 people per square mile.) (These figures are from the 1999 World Population Data Sheet from the Population Reference Bureau. This data can be updated annually from the Population Reference Bureau's World Population Data Sheet, or from World Development Indicators from the World Bank.

   Variation Format this as a quiz to hand out.

2. Write a brief essay on crowding. (For example, in an elevator, on a boat, in a classroom full of students, or on a sports team with too many players.) What effect did crowding have on you and the people around you? Was it stressful? If so, how did you respond? How did the people around you respond? What did you do to relieve that stress? What would happen if everybody reacted that way?

How would you feel if this situation were permanent?

3. Determine the increase in global population in one year. Identify one or more countries approximately that size. Then look at a world map, and determine where a new country that size could be placed every year for 10 years. What resources would be required to support that country? What infrastructure would be required to support that country? What sort of geography and environment currently exist where you decided to place that country? How would that geography and environment change if a country of that size were placed there? Do the existing geography and environment offer the resources you determined were necessary to support the new country? If not, how might those resources be provided?

4. Determine the increase in global population in one week. Identify three or more cities approximately that size. Look at a world map and find practical and livable locations in which to put a city of that size every week for 12 weeks. How much additional area, in terms of farmland, watersheds and forests, would be necessary to support that city? Are those resources available in the locations you chose? If not, how might those resources be provided?

5. List historical factors that limited world population growth. Determine how many of those factors exist in your life. List any new factors that might limit world population growth. How many of those factors exist in your life?

6. Write a short essay defining "sustainability." List the elements and resources in your life you consider essential. Does it appear that these elements are currently being managed in a sustainable manner? What indicators lead you to this conclusion? If it does not appear that these elements are currently being managed in a sustainable manner, briefly describe how you would manage them. Does it appear that these elements can be managed in a sustainable manner in the future, if human numbers and lifestyles keep expanding? If not, how might that problem be addressed?

7. Imagine it is the year 2100. You're writing the history of the last century, and the population of the Earth has fallen to 3 billion. What happened?

8. How will we know when the Earth is "full?" List 10 potential indicators of this. Now determine how many (if any) of these indicators are apparent to some degree today. How might these impact you and your future?

9. Some growth advocates argue that the world is not overpopulated because its entire population could fit in Jacksonville, Florida. (At one square foot per person.) Draw or tape a three by three foot square on the playground or classroom floor, and place 9 students in it. Leave them there while the class considers whether the lifestyle needs of those students can be met in that space. Discuss what other needs those students have beyond room to stand. How large

a "footprint" do they need at school, including desk and study space, playground space, bathroom space, lunchroom space, library space, etc. Observe and describe the behavior of the students in the square. Ask the students in the square to describe their feelings about having to live in one square foot.

10. Using the one square foot per person concept, ask the students to determine what other needs people have, and how large a "footprint" is required to meet those needs. For example, where did the food to feed those in the square come from? Where did their water come from? Where did their energy come from? Their clothing? Their books? Where do they sleep? What is required to produce that space and that shelter?

11. Based on the discussion above, and the earlier question about the necessary components of a fulfilling lifestyle, ask the students to calculate how large a "footprint" they really require. Ask what the consequences might be of six billion people having a similar size "footprint."

12. Calculate the doubling time of different regions and countries listed in the World Population Data Sheet. (Divide 70 by the rate of natural increase listed in the Data Sheet. I.e., in 1998, Somalia had a natural increase rate of 3.2%. 70 divided by 3.2 equals a doubling time of 21.9 years.) Select at least one country from an industrialized region such as Europe or North America, and at least one from a developing region such as Africa, Asia or Latin America.

13. Graph the comparative doubling times of Africa, Asia, Europe, Latin America, North America and Oceania. Discuss how these doubling times might affect future availability of essentials such as food, water and fuel in each of those regions. How might scarcity of food, water or other resources impact those areas? How might other regions be impacted by destabilization of any given region due to scarcity?

14. Construct a display to explain how much of the Earth's water is available for human needs. Fill a liter container with water. Take out two and a half percent (25 ml) to represent the amount of fresh water on earth. Of this amount, remove 70 percent (17.5 ml) to represent the amount of water trapped in glaciers or too deep in the ground to realistically recover. The remainder - less than one percent of the Earth's total water supply - is left to support lakes, rivers and fresh water ecosystems, as well as human needs for agriculture, drinking and washing.

15. Determine the source of water for your community. Graph the available limits of that resource over the period of an average year. Predict events or circumstances that could negatively effect the availability of your drinking water. Brainstorm ways to prevent loss of drinking water.

16. Write a law for your national legislature to consider that makes it a criminal act to introduce any sort of toxic waste into any body of ground or surface water in the

country. Include provisions, penalties and justifications. Prepare to answer the arguments from business leaders who contend it will put thousands of people out of work.

17. Write a sustainable management plan for a watershed containing farmland, forest resources, salmon spawning streams and other wildlife habitat. Attempt to preserve each of the elements listed, while providing for economic and recreational opportunities for the area's human population.

18. Make a chart or diagram that illustrates the three levels of the atmosphere. Identify the causes of damage to them, and list the resulting impacts on local, regional and global environments. List potential solutions to each of those impacts, while trying to balance environmental protection and human health with economic concerns. (If you are devising a tax structure, for example, how do you prevent it from harming poor people?)

19. In Mexico City, the air quality is so degraded that cars with certain numbers on their license plates are not allowed to drive on designated days. For example, if your plate ends with 1 or 9, you'll be fined if you drive on a Monday. Draft similar laws to control air pollution, water pollution or resource depletion.

20. If you were unable to use any hydrocarbon-powered vehicle for one day every week, what would you do? Plan four hydrocarbon-free activity days for your family and your neighborhood.

21. List what you consider the most important renewable and non-renewable resources. Then identify those that are available in your community, and rank them on the chart to indicate their importance to you. Identify those local resources that are less available now than they were 30 to 50 years ago. Identify those local resources that are more available now than they were 30 to 50 years ago. Discuss the possible reasons for the changes in resource availability, and the implications of those changes for your community. If any of those resources are not available in your community, how and from where does your community acquire them?

22. Robert Kaplan suggested in his article, "The Coming Anarchy," in the Atlantic Monthly, that the environment is the national security issue of the early 21st century. How might population growth, resource scarcity, disease, migration, environmental degradation and ethnic tensions combine to threaten security in both developing and industrialized regions? How might your nation, and how might you personally, be impacted by these trends? Break into collaborative groups. and ask each group to report their conclusions briefly to the class.

23. Create a scenario of a water-scarce country. Walk a mile to get a bucket of water and bring it back. Try to use this bucket of water for all your household needs. Do this every day for a week. What is the value of that bucket of water?

24. Do a two day fast: no food, just water for two days. (Some schools do this and then donate the lunch money saved to Oxfam or another relief organization.) Discuss how it feels when you're hungry, and how hard it is to work. See if you can find someone in your community who has experienced hunger or starvation, such as a former prisoner of war, and ask them to speak to your class about that experience.

25. List on a white board or flip pad what you consider the most important renewable and non-renewable resources. Rank them to indicate their importance to you, and identify those that are available in your community. Of those, how many appear to be less available now than they were 30 to 50 years ago? Why do you believe this is the case? How many appear to be more available? Why do you believe this is the case? Discuss the possible reasons for the changes in resource availability, and the implications of those changes for your community. (This may be adapted to a Research Assignment in which students investigate those assumptions.)

26. Break into discussion groups to determine student concerns and perceptions regarding immigration. Ask each group to outline those and summarize them to the class. Turn this into a Research Assignment by asking those groups to investigate and test their assumptions, then report again to the class on changes of opinion and insights their research stimulated. (This may also form the basis for a classroom debate on immigration policies.)

27. As a group, write (from a sustainable population perspective) "10 Things You Can Do to Save the Earth." What things can you, as students, do today? Design a plan to get that message out to the larger public.

28. Every great movement starts with small steps. As a group, list your small steps to make things better for the Earth and its inhabitants.

29. Design a new "Index of Progress" to measure advances or declines in the human condition. List the indicators you believe are important to measuring human progress. Include indicators of environmental, economic, physical and social health. Rank these indicators in terms of importance, and determine how to measure them. Compare rankings on your Index to conventional measures such as GDP, the stock market, or the Consumer Price Index.

30. In 2065, the World Government has declared that overpopulation has inflicted tremendous damage on the planet and greatly reduced the quality of life for all people. Henceforth, a proposed law states, couples may not marry before age 30, and will be sterilized after the birth of their first child. A protest movement is forming in your neighborhood. Do you join it, or support the government's decision? Defend your position in debate.

31. You have been declared Dictator of the World. You recognize that overpopulation

has terribly damaged the environment and the quality of life of all citizens, and decide on a policy of reducing population to a sustainable level. How would you do it?

32. As advisors to the president of a prosperous nation, your class must choose between accepting increasing numbers of immigrants from poor nations, spending large sums of money to improve the conditions and thus reduce "push factors," in those poor nations, or spending large sums of money to seal your borders and keep out immigrants drawn by the "pull factors" of social well-being and economic opportunity in your country. Each seems to threaten your citizens with an altered lifestyle due to significant reallocation of resources. What recommendation would you make? How would you defend it in debate?

33. Write your vision of the world in which you would like to live in 50 years. Describe the political, environmental, social, economic and spiritual conditions you hope for. Describe the technologies and infrastructure you envision, and your preferred form of governance, and explain how they fit with your vision. And describe a just, humane plan to achieve that vision.

Carrying Capacity

Demographic Concept: Natural Increase, Carrying Capacity

Grade Level: 5-12

Time Required: One class period

Connection to Curriculum: This activity emphasizes the interpretation of data and computation to understand the potential impacts of population growth on the carrying capacity of individual nations and regions, and the planet as a whole.

Learning Objectives: As a result of completing this activity, students will apply skills to calculate population growth due to natural increase, and consider potential social, environmental and economic impacts of such growth. Students will demonstrate an understanding of current world population trends by modeling natural increase rates of selected nations, regions and using the Population Reference Bureau's "World Population Data Sheet."

Inquiry: What is the effect of different rates of natural increase on carrying capacity, and what potential impacts of given population levels may result?

Materials Required: World Population Data Sheet from the Population Reference Bureau. One clear container, preferably at least one gallon in size, with an open top adequate to reach into to remove water. One equal size container for water storage. Blue food coloring to tint water. A variety of measuring cups, ranging from one quarter to one cup in size. A towel or tray to catch spills.

Strategy:

1. Create a visual scenario to model effects of population increase on carrying capacity. Fill the clear container representing "population" about one half full with water and add enough food coloring to make water quite visible. Explain that the air volume in the container above the blue water represents the habitat for all the other species on the planet. Fill the other container about two thirds full with clear water.

2. Divide the class into two groups, and give each group one measuring cup. Base the size of the cup each group receives on relative birth and death rates of any given country or region. For example, if students choose Africa as the demonstration region, have them look up the birth and death rates for Africa in the Population Reference Bureau's World Population Data Sheet (41 and 13 per thousand respectively) and select measuring cups representing that difference. For convenience, the group representing births might be given a one cup

measure, and those representing deaths given a one quarter cup measure. If North America is chosen (birth and death rates 15 and 9 respectively) use a one half cup and one quarter cup measure to approximate those values.

3. Instruct each group to line up on opposite sides of the room and ask students from each group to come forward individually. Those representing birth rates fill their cup from the supply container, and add it to the "population" container. Those representing deaths then fill their cup from the "population" container and dump it back into the supply bucket. Keep the process going until the "population" container is dangerously full, and any more increase will cause an overflow.

4. Lead a discussion of the results. Ask students what they observed. (The water level rose, and as "population" increased, "habitat" for the other species deceased. If population increase continued, the level would have reached the top of the container, and all other species would have been displaced. If population had increased further, the container would have overflowed. If that overflow were really the people the demonstration represents, the results would be likely be massive deaths from famine, war, disease and communal violence.)

5. Ask the students what happened to the color of the water in the "Population" container (it became lighter in color as it was diluted) and how that might compare to depletion of the earth's resources as carrying capacity was approached. Ask them to describe possible impacts of this scenario on local environments, economies and social institutions, and how those impacts would affect their own lives.

6. Ask students what policies they might implement to prevent the loss of habitat and the extinction of species, and the depletion of resources.

When the Chips are Down

Demographic Concepts: Geometric Progression, Carrying Capacity, Environmental Stress, Scarcity and Scarcity-induced Conflict

Grade Level: 6-12, but adaptable to any grade level above 4.

Time Required: One class period

Connection to Curriculum: This activity emphasizes the manipulation of data using poker chips computations to understand the major impact seemingly minor changes in population growth rates and consumption patterns can make over only a few generations.

Objectives: As a result of completing this activity, students will apply skills to calculate varying growth rates of population size and consumption patterns, and consider potential social, environmental and economic impacts of those changes.

Inquiry: What are the impacts, carried out over four generations, of different population growth rates? What are the multiplying factors of increasing population and consumption? How do lifestyle decisions interact with population growth in determining potential impacts? How does growth impact the resources, governance, and institutions of countries?

Materials Required: A selection of at least 500 poker chips. (Ideally, supply different colored chips to indicate social and ethnic diversity . It's best to count out the required chips for each group and each generation in advance to make things go somewhat faster.) One sheet of butcher paper per group, roughly 2 _ or 3 feet long, or three Easel Pad Post-its (our personal favorite, because they stick to walls or tables, and won't bleed through). Six wide-line marker pens or, preferably, three sets of washable markers, so countries can be drawn in color. (Playing this on a table is preferred, although the floor can be used.)

Strategy:

1. Divide the class into three groups. Each group will model different patterns of population and consumption increase over four generations, using poker chips to represent different family sizes in different countries.

2. Ask each group to brainstorm what "resources" they want in their country, and consider the conditions under which they would like to live. "Resources" might include farmland, forests, water, minerals, infrastructure, parks, wilderness, and more. Encourage students to consider and list what structures or institutions they

might choose for their "county," including type of governance. Instruct each group to choose one member to record these decisions, and another as the "national artist."

3. After the groups have had an opportunity to consider and articulate their needs and desires regarding their "country," ask them to name their country and draw it on the paper or Post-its.

4. When these tasks are completed, lay out the butcher paper sheets or Post-its side by side on a large table, and gather students around the table.

5. Review the concepts of relative environmental impacts and how the "environmental footprints" of individuals and nations vary depending on both population size and consumption habits. (Larger population have a larger "footprint" because they require relatively more resources to support them. Eating an animal protein-intensive diet, for example, requires much more farmland than a vegetarian diet. Having automobiles means roads, repair shops, and parking lots must be built, thus eliminating more habitat.)

6. Instruct each group to model population growth and development over four generations in "their" country. Emphasize that "people" cannot be placed outside the borders of countries - that falling off the edge is death through famine, war or disease. Emphasize that stacking of chips is not allowed! The first group will model a doubling of population but with a static level of development. (The progression will be 2, 4, 8, and 16 chips) The second group will model a doubling of lifestyle and consumption in each generation, along with a 50% increase in population, just as some rapidly industrializing nations such as the Asian "Tigers" have experienced. (This progression will be 3, 9, 27, 81). The third group will model both a doubling of population and a doubling of lifestyle each generation, or a an environmental footprint that is quadrupling each generation. (This progression will be 4, 16, 64, 256.)

7. Place one chip on each country as a core population, then have the groups model one "generation" at a time. (It's easiest to control this by handing out the appropriate number of pre-counted chips for each generation only after each cycle is complete.)

8. Observe the progression of the models. The group modeling a doubling per generation and a fixed lifestyle will finish their task quite soon, and with minimal difficulty. The group modeling a trebling in impacts, or "footprint" size, through population and consumption increase will take somewhat longer, and will confront decisions about how to handle growth, and allocate resources. The group modeling a doubling of population and consumption will take much longer and need much more room.

9. As the generations progress, the National Advisory Council will be forced to decide which resources to deplete to accommodate their population's needs. They may choose, for example, to place chips on areas previously reserved as parks, forests, or wilderness, or to "invade" a neighboring country, rather than drastically curtail their lifestyle, or let their people "die." Ask the group what the impacts of those decisions might be, and what effect they would have on the quality of life and social institutions they envisioned for their countries. Would democracy survive, for example, or might a totalitarian state emerge in response to the increased stress?

10. As signs of stress appear, ask whether students see this occurring in real life. (These are inevitable, because all the chips won't fit in the faster growth models without overrunning the resource base. Situations that may arise as this is played out include deforestation, loss of habitat, migration, border incursions, "brain drain," and invasion of neighboring countries to support population needs. Some participants have even eliminated chips of a particular color from their countries, modeling ethnic cleansing.)

11. Have the groups compare their models, and lead a discussion of the results. Ask each group to calculate what would happen if the scenario were carried out for two more cycles, and what decisions they might be forced to make in response.

A Hill of Beans

Demographic Concepts: Natural Increase, Migration Push/Pull Factors

Grade Level: 9-12, but adaptable to any grade level above 4.

Time Required: One class period

Connection to Curriculum: This activity emphasizes the manipulation of data using dried beans to understand the patterns and impacts of population growth and migration.

Objectives: As a result of completing this activity, students will apply skills to calculate population growth rates of different fertility levels, and consider potential social, environmental and economic impacts of population increase from internal growth and immigration.

Inquiry: What is the effect on population levels of natural increase and immigration, and what are the potential social, environmental and economic impacts of such growth?

Materials Required: World Population Data Sheet from the Population Reference Bureau. Three pounds of dried beans; one pound each of white, black and red or brown. A school lunch tray with at least four compartments, and preferably six compartments.

Strategy:

1. Create a visual scenario modeling natural increase and migration to demonstrate the effects of population growth on environmental, social and economic systems.

2. Divide the class into work groups, and give each group one set of the materials listed above. Ask each group to create a scenario by selecting a country or region from the World Population Data Sheet and determining its rate of natural increase (births minus deaths.)

3. Instruct each group to construct a model of the country or region they have chosen by placing beans in one of the smaller compartments of the tray and filling it about three quarters full with beans of one color, and to place the remaining beans of that color in the large compartment for storage. Ask them to fill two adjacent compartments about three quarters full as well, using a different color bean for each.

4. Instruct each group to begin adding beans from the storage compartment to the compartment representing "their" country in increments equal to the number of

births listed for that country. After each addition, they should remove from their "country" a number of beans equal the deaths listed for their country, and place them in the storage compartment.

5. After a few cycles, announce there has been a gold strike in their country, and to transfer a number of beans from an adjacent country equal to five times the annual number of births to represent immigration as citizens from neighboring countries rush in hoping to strike it rich. Then announce an increase in the birth rate by 10 births to indicate that people often have more children in times of great social and economic optimism.

6. After another two cycles (adding both for natural increase and immigration from the adjacent country) announce that a war has broken out in the other adjacent country, and that thousands of citizens from that country are fleeing to "their" country as refugees. Ask students to add a handful of beans from that country to "their" country to simulate this. If their country is not overflowing by this time, ask them to resume modeling natural increase until beans begin to spill out, adding another handful of refugees each time.

7. Have the groups compare their models, and lead a discussion of the results. Ask each group to explain what they observed. (Such as: population was relatively stable, depending upon countries chosen, but was quickly unbalanced by immigration; population was already been straining local institutions, and immigration multiplied that strain.)

8. Ask the students to describe possible impacts of each scenario on local environments, economies and social institutions. Ask them to compare those impacts if each scenario were to take place in an industrialized nation or a less developed region.

9. Ask them whether the changing composition of the population (the mixture of black, white and brown or red beans) might lead to ethnic or economic tensions, and what some possible implications of that tension might be.

10. Ask the students how they might feel if their country were to experience dramatic growth from immigration driven by outside factors, and how they might want their government to respond.

Everything is Connected

Environmental Concepts: Interconnectedness, Sustainability, Relative Impacts

Grade Level: 5-12

Time Required: One class period

Connection to Curriculum: This activity emphasizes the interconnectedness of natural systems and human economic and social activities.

Objectives:

- create an understanding that human activity impacts both local and global economic and environmental systems
- explore ways in which individuals and cultures can make sustainable decisions
- explore the concept of biodiversity, and understand what it means in the context of environmental health and well-being
- understand that economic development issues and practices can and should be examined from a perspective of local and global environmental, economic and social health.

Inquiry:

- How does local economic and social development connect to the global economy, and global environmental and social health?
- What happens to each (economy, environment and social health) when we undertake a specific development activity?
- How does what we do here affect others far away, and how do they affect us?

Materials Required: One ball of strong string or yarn, at least 200 feet in length.

Strategy: (Prior to Illustration)

1. Ask students to gather scientific information which has a bearing on the discussion of environmental impacts and sustainable development
2. Ask them to analyze information in global, regional, and local contexts

3. Discuss the interdependency of all life and all human activity

Strategy: (During Activity)

1. Arrange the classroom as a discussion group, with students forming a loose circle facing each other.

2. Ask one student to name a plant or animal that exists in your region, and give that student the ball of string or yarn.

3. Ask another student to name an organism or animal that eats, is eaten by, or is otherwise dependent upon the first. Instruct the first student to hold the end of the string or yarn and pass the ball to the second student.

4. Continue asking for organisms which have a relation to the preceding organisms until all students are connected by the string or yarn.

5. Many organisms may be interrelated to others in this chain. If so, the string or yarn should be passed to the student representing that life form more than once.

6. Ask the students to choose one organism from this chain, whether a plant, animal, insect or microorganism. Identify the student representing this organism and ask him or her to tug on the string. Ask who felt the tug. Have them tug in turn.

7. Identify where and how human interactions impact the chain of organisms. Ask students to list human activities which could disrupt this ecosystem.

8. Ask students to research this ecosystem and report on the impact of human activity on the health and well-being of all species in this system.

9. Ask students to go through the ball of string exercise one more time. This time ask them to identify linkages between local economic, environmental and social practices and the global economy. Repeat this exercise with the focus on the health of the global community.

10. Ask students to identify economic or development practices in a different hemisphere which has an impact in your region. An example could be the destruction of the Amazon rain forest to permit raising of cattle for the fast-food industry, or destruction of songbird habitat for "sun grown" coffee plantations.

11. Conduct one final demonstration with the ball of string. Ask the students to identify one specific organism in the chain and ask the student representing that organism to let go of the string entirely to represent the organism's extinction. Ask the students to describe what happens to the rest of the chain?

Follow Up Activities

1. Have students research the ecosystem in which your school is located. Include in this examples of species which may not have existed in this ecosystem before introduced by humans, or which no longer exist.

2. Ask students to prepare a report on how human activity has changed the ecosystem in which they live. Ask them to examine the roles agricultural, residential and industrial development have played, and especially how human numbers and lifestyles have influenced this.

3. Ask students to formulate development policies that might be implemented to improve the environmental, economic, and social health of their ecosystem.

4. Ask students to identify what they, as individuals and as a group, could do to begin living a more sustainable lifestyle.

Planet Amoebae

Demographic Concept: Geometric Progression, Doubling Time, Thresholds

Grade Level: 9-12, but adaptable to any grade level above 4.

Time Required: One class period

Connection to Curriculum: This activity emphasizes the interpretation of data and computation to understand geometric progression and doubling time as they relate to population scenarios.

Learning Objectives: As a result of completing this activity, students will apply skills to alculate population doubling due to natural increase, and consider potential impacts of such growth.

Inquiry: What is the effect of population doubling on carrying capacity, and what potential impacts of given population levels may result? What is the time sequence of population doubling?

Materials Required: None, although student teams may be assigned to create graphics to accompany this illustration.

Strategy:

Explain the following scenario to students.

1. It's a small blue-green planet inhabited by friendly amoebae who are all busy doing what amoebae do - replicating. They've never given their replication - or the fact that it causes their population to double every minute - any thought. After all, they tell themselves, "What amoebae do is replicate. It's part of our identity and our right."

2. It's eleven o'clock in the evening, and the amoebae are doubling every minute. At exactly midnight, Planet Amoebae will be entirely covered by amoebae, and there will be neither room nor resources to support any additional amoebae.

3. Based on the above scenario, at what time will Planet Amoebae be 1/2 full? 1/4 full? 1/8 full? 1/1024 full?

4. At 11:55 the amoebae realize the situation is getting serious and send out scouts to find another planet to colonize. At 11:59 the scouts come back and excitedly report, "We've found three more planets we can expand onto." At the amoebae's

current growth rate, how long after midnight will it take to fill those three planets?

5. Ask students to project how many planets would be needed if the amoebae were "only" growing at the same rate as world population today. (For ease of calculation, use the current doubling time of world population - approximately every 50 years - and the projected world population of six billion in the year 2000.) Run the scenario out for the next 2,000 years.

6. Lead a discussion of the impacts and implications of the amoebae's growth rates, in terms of what it means to their planet, and to their species. Ask students how the amoebae might restructure their society and habits in order to survive. Ask what stresses these changes might inflict on their society, and how the amoebae might cope with having to alter their traditions and culture in order to survive.

In the News

Demographic Concept: Natural Increase, Carrying Capacity

Grade Level: 5-12

Time Required: One class period

Connection to Curriculum: This activity emphasizes the interconnectedness of population growth and carrying capacity and environmental, economic and social conditions.

Learning Objectives: As a result of completing this activity, students will apply critical thinking skills to examine the interconnectedness of environmental, economic and social issues, consider underlying causes and effects, and outline potential solutions.

Inquiry: What environmental, economic and social situations presented in the news media are of greatest concern? What are the underlying causes of those situations? What are potential solutions to those situations?

Materials Required: A variety of news sources - newspapers and magazines, radio or television news and Internet news services. A World Population Data Sheet from the Population Reference Bureau. Butcher paper or large flip pads and marking pens, or adequate white board space for student group to work.

Strategy:

1. Ask the class to briefly review the available news materials and/or recall a recent news broadcast they have seen or heard. Ask them to list the news items they consider most important, and summarize each in as few words as possible. "Bosnian war," for example, "African famine," or "Violent crime."

2. Divide the class into groups of from four to seven students, depending on class size, instruct each team to designate an illustrator, and to create a drawing representing the human community, with incorporated components of "population," "scarcity / poverty," and "lifestyle."

3. Ask each group to select three news items about issues that most concern them and categorize those concerns around the symbol of the human community.

4. Then ask the students to connect the situations about which they are concerned to the underlying causes. Famine, for example, might connect to population, poverty and lifestyle. (Too many people compete for limited resources, creating

food scarcity. Widespread poverty means some people are too poor to purchase food even if enough is available. Or some people live wasteful lifestyles and hoard resources, while others go hungry.) War and conflict might connect to population, poverty and lifestyle, too. (Available resources are too few to support the population. People faced with scarcity become desperate enough to fight for resources. People are willing to engage in conflict rather than suffer a decline in lifestyles.) Crime might also connect to population and poverty. (Too many people compete for available jobs, leading to unemployment, lack of opportunity and desperation.) Or unequal distribution of resources creates a class of chronic poor. (So people respond by turning to crime.)

5. See how many of the issues also connect to each other. For example, war and environmental damage are often closely linked, as are population, poverty, social unrest and environmental damage.

6. If the issues identified can be seen on a national or regional level, ask the students to determine the rates of population growth, education and the per capita GDP in those nations or regions. Ask whether there is a connection between population growth rates, education, income and the issues they have identified as of concern.

7. Ask each group to identify the one news item they consider most important and write a brief paper with a paragraph or two each defining the situation, why they consider it important, the underlying causes, and potential solutions.

8. Bring the students back together and allow each group a few minutes to report their findings to the class. Consider extending this discussion by asking the class to identify what they consider the three to five most critical situations, and assigning student teams to research each one in depth and report their findings back to the class in one week.

What's Your Favorite Meal

Demographic Concept: Relative Impacts, Carrying Capacity

Grade Level: 5-12

Time Required: One class period

Connection to Curriculum: This activity emphasizes the interconnectedness of human numbers and lifestyles and environmental carrying capacity,.

Learning Objectives: Students will consider the impacts of ordinary and seemingly innocuous activities, and understand the interconnectedness of human numbers and lifestyles and economic and environmental issues.

Inquiry: What goes into producing are the environmental, economic and social impacts of a typical American diet and lifestyle? How do local actions connect to regional and global impacts? What would be the consequences if our lifestyle were adopted by the rest of the world?

Materials Required: Writing materials. Butcher paper and tape, or Post-it Easel Pads are preferred, so students' work can be displayed on a wall during their explanation.

Strategy:

1. Arrange students in groups of four to eight, depending upon class size, to create three to five groups. Ask each group to agree on a meal they would like to share ad list as many of the components of that meal as possible. Ask them to describe where and how they would obtain that meal. (At the market, a restaurant, or take out) Ask students to list all the resources, processes and technologies required to produce, process, deliver and serve it. (For example, farmland, water, farm machinery, fertilizer, pesticides, petroleum fuels, electrical energy, transportation, refrigeration, markets, restaurants, labor, etc. See how many they can list.) Ask them to define what impacts result from each of the processes and technologies in that series. (For example, soil erosion, pesticide runoff, air pollution, freeway crowding, sprawl.) Allow about 15 _ 20 minutes for this process, and check in with each group to guide the discussion.

2. Ask each group to report briefly to the class on their favorite meal, and what was involved in providing it to them. After each group reports, open the discussion to the other students to expand on or question.

3. Ask what impacts they would predict if twice as many people were to live in their

community and enjoy the same meal, and what impacts they would predict if all the world's people were to enjoy the same meal.

4. Ask what impacts they would predict if world population were to double, and all the world's people were to enjoy the same meal. Ask what the possible environmental, social, and security consequences might be if only a small percentage of the world's people were able to enjoy such a meal, while the rest of the world went hungry.

5. Ask whether students consider the impacts of all these scenarios as negative, and if so, what potential solutions they might offer to mitigate those impacts.

Variations. For younger students, it may be appropriate to assign a given meal to groups, or even assign a particular meal to the class, and give a part of that meal to each group to brainstorm. (Using the example below, one group might do the hamburger, one the fries, one the condiments, and one the drink. Alternatively, you might give out the following reading in advance, to give students an idea of the tremendous number of products and processes necessary to feed us.)

This may also be done as part of a broader assignment we call, "What's Your Shoe Size?" In that variation, assign one group the task of working on the meal, while others grapple with, "How Did You Get Here?", "What Are You Wearing?", or "What's in Your House?"

Hondurica

Demographic Concept: Interconnectedness of Demographic, Environmental, Economic and Social issues. It is suggested this follow, "When the Chips Are Down," and be undertaken after students have read and discussed "Personal and Global Solutions."

Grade Level: 6-12

Time Required: One class period

Connection to Curriculum: This activity emphasizes the interconnectedness of human numbers and lifestyles and environmental, economic and social conditions, using a model "country."

Learning Objectives: Students will examine connections between population, poverty, social health, education, development, and the environment, and will consider opportunities and methods to apply holistic solutions in culturally-appropriate ways.

Inquiry: How do indicators of social and economic well-being correlate to population growth rates? How do these factors, in turn, correlate to environmental, economic and social impacts, and how do those impacts effect regional and global security? How may solutions be implemented in a just, holistic manner with only limited resources?

Materials Required: One copy of the following "National Profile" for each group.

Strategy:

1. Arrange students in groups of five to eight, depending upon class size, to create three to five groups, and explain the following scenario.

2. Your group is the Advisory Council to the President of the small Latin American nation of Hondurica. You recognize that your country's population growth rate is not sustainable, and that increasing numbers of people will soon overwhelm the economic, environmental and social systems of your country. Your small nation is short of schools, hospitals, farmland and jobs, but even though they are poor, the people are friendly and industrious. Examining the list of indicators below, you realize that your government will soon confront increased land scarcity, as well as a growing number of young people who will need not only social services, but also jobs. Your nation has been guaranteed a series of grants and loans from other nations, but not in amounts large enough to undertake major development in the traditional sense. Devise a plan to allocate those scarce resources to improve the quality of your peoples' lives, in order to stabilize population, and

protect the environment. Explain what you would choose to invest in, and why. Also devise strategies to attract investment in sustainable development, negotiate "debt for nature" trades, and obtain additional resources and assistance from the international community.

3. After guiding and facilitating this discussion with each group, ask each group to report briefly to the class on their plan. After each group reports, open the discussion to the other students to expand on or question the proposed solutions.

4. Ask what tradeoffs these solutions would require, and how those who benefit from the existing social and economic structure might respond to significant changes. Also ask how both religious leaders and military leaders might respond, and how they might be included in the planning and implementation process.

5. Finally, ask what the ultimate outcome would be if all these plans were to be effectively enacted. What would Hondurica look like in 20 years? How would it look if solutions were not enacted? How might either scenario impact security in the region and the hemisphere?

Republic of Hondurica
National Profile

Population in millions	5.7
Annual natural Increase	2.6 %
Doubling time	29 years
Infant mortality Rate	36
Total Fertility Rate	3.9
Portion of population under age 15	39 %
Per Capita GDP (1996 US $)	1,655
Population per square mile	253
Arable land per capita (hectares)	0.24
Fresh water per capita (m_ 1996)	23,881
Annual average deforestation rate	2.55 %

Summary: Hondurica is a small Central American nation with a rapidly expanding population. Ethnic composition is primarily mestizo (mixed Amerindian and European) with a significant percentage of Amerindian, and a small percentage of black, and white. Religion is approximately 85% Roman Catholic, with the remainder split between

Protestants and traditional religions. The economy is primarily agricultural, with some extractive industries such as mining and logging. Hondurica has historically been ruled by military-backed regimes, but has recently transitioned to a democratic government.

Environmental issues: Hondurica is grappling with: deforestation, largely a result of the clearing of land for cattle ranching and family farming; soil erosion; water pollution; contamination of soils from disposal of toxic wastes; fishery resources threatened by pollution from agricultural runoff; land degradation; and biodiversity declines due to habitat loss.

Social issues: Hondurica confronts: increasing crime - both petty and violent; income inequity and poverty; limited infrastructure, including education and medical facilities; some indigenous resistance movements / insurgen

Economic issues: Hondurica must work with: limited transportation and communications infrastructure and technology; moderate to high unemployment and underemployment; limited investment and substantial external debt; a modest economic growth rate; moderate to high inflation; and significant budget and trade deficits.

(Data presented is an averaging of six Central American nations drawn from the 1998 World Population Data Sheet by the Population Reference Bureau, World Development Indicators 1998 by the World Bank, the CIA World Fact Book 1998, and US State Department Travel Advisories.)

Final Projects

Create posters demonstrating your message of the interconnectedness of population, the environment, and economic and social issues. Post them at local libraries, in your school, or on community bulletin boards with an opportunity for readers to comment on them.

Write and record radio announcements with your message of the interconnectedness of population, the environment, and economic and social issues, and send them to local radio stations with a request for community service air time.

Write articles, letters to the editor and / or opinion pieces on this issue, and submit them to local newspapers. Supply photos, with captions, of students working on population issues.

Plan and organize an informational meeting in your community or school to express your concerns and raise community awareness of population issues. Present a brief overview of your research and conclusions on the subject, and the linkages between population and other issues of concern. Establish rules of debate that encourage people to join in the discussion, without making personal attacks on speakers with different points of view.

Create a World Wide Web page on population issues, posting your research, conclusions. and graphics you have created. Provide an opportunity for e-mail comments and discussions.

Join in Internet news group discussions on population issues, participate actively over a period of time, and submit your findings.

Create a play, computer presentation or video to communicate population issues and impacts.

Create a large "matrix" poster or display showing the interconnectedness of human numbers and critical environmental, economic and social issues. Explain not only the linkages between problems, but also linkages between solutions. Invite the public in to view it, and provide an opportunity for comment.

Section 6. Additional References and Resources

For Further Study

Books

The Stork and the Plow
by Paul and Anne Ehrlich, Gretchen Daily
Grosset/Putnam, 1995

The Population Explosion
by Paul and Anne Ehrlich
Simon and Schuster, 1990

Healing the Planet
by Paul and Anne Ehrlich
Addison-Wesley, 1991

Global Issues, an Introduction
by John L. Seitz
Blackwell, 1995

Living Within Limits
by Garrett Hardin
Oxford University Press, 1993

A Green History of the World
Clive Ponting
Penguin, 1991

Guns, Germs and Steel: The Fates of Human Societies
Jared Diamond
W. W. Norton, 1997

Our Ecological Footprint
Mathis Wackernagel and William Rees
New Societies Publishers, 1996

How Many People Can the Earth Support?
by Joel Cohen
W.W. Norton, 1995

Population, Consumption and the Environment: Will Growing Population Destroy the Planet?
Pew Global Stewardship Initiative

Beyond the Numbers, a Reader on Population, Consumption and the Environment
edited by Laurie Mazur

World Scientists' Warning Briefing Book
edited and published by the Union of Concerned Scientists, 1993

The Consumer's Guide to Effective Environmental Choices
Michael Brower and Warren Leon
Three Rivers Press, 1999

PAI Booklets:
Challenging the Planet
Why Population Matters
Conserving Land
Sustaining Water
Stabilizing the Atmosphere
Catching the Limits:
Population and the Decline of Fisheries
Economics and Rapid Change:
The Influence of Population Growth
by Robert Engelman et al
Population Action International

Earth Odyssey
Mark Hertsgaard
Broadway Books, 1998

PRB Booklets:
Population: A Lively Introduction
World Population Fundamentals of Growth
World Population Toward the Next Century
The Future of World Population
New Perspectives on Population: Lessons from Cairo
World Population Data Sheet (annual)
World Population and Environment Data Sheet
by various authors
The Population Reference Bureau

Worldwatch Institute

State of the World (annual)
Vital Signs (annual)
Full House
Last Oasis
Who Will Feed China?
How Much is Enough?
Saving the Planet
Tough Choices: Facing the Challenge of Food Scarcity
Fighting for Survival: Environmental Decline, Social Conflict, & the New Age of Insecurity
The Natural Wealth of Nations
Life Out of Bounds
Beyond Malthus
By Lester Brown et al
Worldwatch Institute

W. W. Norton

Stuff: The Secret Lives of Everyday Things
Misplaced Blame: The Real Roots of Population Growth
Tax Shift:
How to Help the Economy,
Improve the Environment, and
Get the Tax Man Off Our Backs
This Place on Earth
The Car and the City
by Alan Thein Durning, John Ryan, and various authors

Northwest Environment Watch

Population, Environment and Development
UN Department for Economic and Social Information and Policy Analysis
Population Issues Briefing Kit (annual)
United Nations Population Fund
Human Development Report (Annual)
United Nations Program for Development
State of the World's Children (Annual)
United Nations Children's Fund
World Resources (Bi-annual)
published jointly by the World Resources Institute, UNEP, UNDP, and World Bank

World Development Indicators (Annual)
The World Bank

Periodicals

Choices - The Human Development Magazine
United Nations Development Program

World•Watch (bi monthly magazine)
Worldwatch Institute

Worldwatch Papers (bi monthly issue papers)
Worldwatch Institute

The Amicus Journal (quarterly magazine)
National Resources Defense Council

Population Bulletin (Quarterly)
Population Reference Bureau

Fiction

The Story of B
by Daniel Quinn
Bantam 1996

Ishmael
by Daniel Quinn
Bantam 1992

My Ishmael
by Daniel Quinn
Bantam 1997

Websites

Facing the Future: People and the Planet
www.facingthefuture.org

United Nations Population Fund
www.unfpa.org

United Nations Development Program
www.undp.org

United Nations Children's Fund
www.unicef.oeg

World Bank
www.worldbank.org

US Census Bureau
www.census.gov

Population Action International
www.popact.org

Population Reference Bureau
www.prb.org

Zero Population Growth
www.zpg.org

World Resources Institute
www.wri.org

Union of Concerned Scientists
www.ucsusa.org

Worldwatch Institute
www.worldwatch.org

National Wildlife Federation Population Page
www.nwf.org/international/pop/